THE RHODESIA

Agricultural Journal.

Issued by Authority of
the Minister of Agriculture and Lands

Vol XXXV, No 2] FEBRUARY, 1938 [5s per annum

LEADING FEATURES.

SALISBURY

PRINTED FOR THE GOVERNMENT STATIONERY OFFICE
BY THE ART PRINTING WORKS LTD SALISBURY

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THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.
(Assisted by the Staff of the Agricultural Department).

PUBLISHED MONTHLY.

Subscription: 5/- per annum; payable to the Accountant, Department of Agriculture, Salisbury.

VOL. XXXV.] JANUARY, 1938. [No. 1

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

We wish all our readers and advertisers
A Happy and Prosperous New Year.

Sulphate of Ammonia for Clovers.—The opinion has been expressed on a number of occasions that heavy dressings of sulphate of ammonia to pastures had a deleterious effect on clovers. A recent article in the *Journal of Agricultural Science* offers a different explanation. In pot experiments with alsike and red clovers, fortnightly dressings of ammonium sulphate applied in solution at rates up to 1 gm. per pot did not injure the plants. The total amount of ammonium sulphate applied to the alsike was relatively enormous, of the order of 24 tons per acre. Soil and plant analyses showed that although abundant ammonia and nitrate (including water-

soluble ammonia) were present in the soil there was little extra nitrogen in the treated plants. It was concluded that the adverse effect of ammonium sulphate on clovers in grassland was due not to the toxicity of ammonium ion but to competition with extra growth of grass produced.

Cultivation to avoid Evaporation.—Mr. B. A. Keen in a paper on the scientific basis of the art of cultivation points out that the capillary theory of water movement in soil is wrong. The pore-space of the soil must be regarded as a series of cells communicating with one another through relatively narrow necks. The boundaries of these cells and necks are formed by the soil aggregates or crumbs, which can be likened to small sponges. The crumbs imbibe water from the rain that percolates down the pore-space, and water is held at the points of contact of the crumbs and also partially fills the pore-spaces. Any surplus drains away and eventually reaches a water-table. When drying conditions occur at the surface, evaporation proceeds by the progressive downward drying of the top layers of the crumbs rather than by the upward movement of water from below to the surface. In other words, most soils are naturally "self-mulching." Similarly when root hairs absorb water, inward movement to the region of absorption will be very slow and over very limited distances. The water held by the soil is to be regarded as relatively static. Modern theory shows, in fact, that it resists movement.

The effects on soil water content and movement attributed to operations such as harrowing and rolling are therefore much less than the old capillary theory asserted. The main function of cultivation is not to exercise a delicate and precise control of soil moisture, but to remove the competition of weeds, to obtain a seed-bed of suitable consistency and to prevent crusts or "caps" forming on certain classes of soil.

Loose Smut in Wheat.—A new method of treating wheat seed in order to free it from a fungous disease called Loose Smut was discovered by R. S. L. Jai Chand Luthra, I.A.S.

Professor of Botany, Punjab Agricultural College, Lyallpur. The old method of treatment involved the use of a thermometer and required skill and accuracy in raising water to a temperature which was sufficient to kill the spores of the disease inside the wheat grain and yet not damage the germinating power of the grain. Consequently the method was unsafe in the hands of unskilled and illiterate people. By the new method the use of a thermometer is rendered unnecessary.

The wheat seed to be treated is merely soaked in water at ordinary temperature for four hours during the morning of a dry day. The soaked grain is then spread in the sunshine till it is thoroughly dried. Experience in India has shown that this treatment is effective in controlling the disease without damaging the germinating power of the seed.

American Aloe.—An enquiry was received regarding the possibility of utilising the leaves (chopped up) of the American aloe, *Agave americana*, for stock feed in drought areas. This is known to be done in some of the drier parts of South Africa. We are indebted to our Chemistry Branch for the following analysis:—

	% Expressed on samples as received.	% Expressed on basis of 100% dry matter.
Moisture...	85.6	—
Ash...	1.75	12.16
Crude protein	.71	4.91
Ether extract	.23	1.63
Fibre...	2.24	15.57
Carbohydrates ... ... (by difference)	9.47	65.73
	100.00	100.00

Nutritive ratio—1:17.3.

Tobacco News.—According to a press communiqué on the Report of the Imperial Economic Committee, not only has the production of flue-cured leaf in Canada, India and Southern Rhodesia greatly increased within recent years, but there has also been a very marked improvement in the quality of the leaf.

The increase in production is chiefly accounted for by the growing preference for cigarettes, made of flue-cured leaf, over pipe and cigar smoking. In the United Kingdom, which is the chief importing market for leaf of Empire origin, "five cigarettes are smoked there to-day for every one which was smoked thirty years ago. Cigarette smoking now accounts for nearly three-quarters of the tobacco consumed."

The Committee in its Report (Reports of the Imperial Economic Committee, Thirty-first Report—Tobacco) state that the prejudice against Empire leaf which existed in the early days of tariff preference (1919) is no longer justified, for the best Empire flue-cured leaf can be, and is, used by manufacturers in the production of cigarettes.

The prejudice may still linger to a certain extent among old smokers but is rapidly disappearing, largely on account of the improvement which is being effected in the quality of the leaf. It is of vital importance, therefore, "that leaf inferior in quality and unsuited in flavour does not reach the United Kingdom."

In this connection the Committee lays considerable stress on marketing and points out that "although an article may enjoy a fiscal advantage, marketing (unless compulsion is to be used) is as important as production when in the last resort the article has to make its way on its merits in a market largely accustomed to a particular type, quality and kind."

Attention is also drawn to the necessity of maintaining a regularity of supply so as to prevent gluts and shortages, for "the tobacco manufacturer has to buy ahead and usually

holds approximately three years' stocks of leaf, to enable him by blending to smooth out variations in the crops of different years and to facilitate the maintenance of a fixed retail price independent of small fluctuations in the price of leaf. Clearly big variations between years, either in the quality or the nature of the leaf or in its price, are as much to his ultimate disadvantage as they are to the producer."

Referring to the system of sale by auction as now operated in Southern Rhodesia, the Committee reports: "Our witnesses representing manufacturing and merchanting interests were in favour of auctions as a system of selling leaf, provided they cover the whole crop, are fully organised, and attract a sufficient number of buyers."

Soil Conservation by means of Grass.

"THE BERMUDA GRASS KING."

A most interesting article by ANGUS McDONALD, entitled "THE BERMUDA GRASS KING," appeared in the October, 1937, issue of the Journal, *Soil Conservation*—the official organ of the Soil Conservation Service of the United States Department of Agriculture—and is reproduced here verbatim, as it is thought to be of considerable interest to the Rhodesian farmer.

The article "COUCH GRASS," which appears elsewhere in this issue, is part of a series of articles entitled "SOWN PASTURES AND THEIR MANAGEMENT," by Mr. C. W. WINDERS, B.Sc., Agr., has been extracted verbatim from the October, 1937, issue of the *Queensland Agricultural Journal,* and should be read as a sequel to "The Bermuda Grass King," for in it Mr. Winders in a very able and explicit manner describes and refers to the management of Couch Grass, which is in reality Bermuda Grass—the two names being synonymous.

This grass is of creeping habit and is very commonly met with in Rhodesia.—Acting Editor.

They will tell you in Fort Smith that Harry E. Kelly is the Bermuda Grass King of Arkansas. He is called the "Bermuda Grass King" because he has over 2,000 acres of Bermuda grass and because he has had it set all over Arkansas and the South and South-west. His work with Bermuda grass has carried him to Australia and all over the United States.

The land south of Fort Smith is the poorest I ever saw. It is a mass of shale with a few inches of soil over it. In some places there is nothing but bare rocks. Some of the hilltops were once entirely bare—"bald knobs" they were called. It was a God-forsaken country; the soil was thin and

washy and great gullies marred the hillsides. In 1887 Harry Kelly moved to the south of Fort Smith. Shortly after he became interested in Bermuda grass.

"I knew that a country could not be prosperous without good pastures," he told me. "When I came to this country in 1887 this field here had been farmed in cotton for 80 years. It was so run down that it wouldn't grow anything. The hillside was a maze of gullies, some of them as deep as your head."

"Where are the gullies now?" I asked. I looked up the long slope that was covered with Bermuda grass from 6 to 8 inches high.

"Come on up to the top of the hill. I want to show you something," said Mr. Kelly.

I drove up the slope. When we got to the top I saw Bermuda grass growing on what was almost a solid mass of rocks. Some of the big, flat sand rocks were a yard across, but they were nearly covered with the long Bermuda runners.

"Bermuda grass will grow where nothing else will," said Mr. Kelly. "It will stop erosion when nothing else will. There is more money in it than in corn and cotton, and it builds up the land. Thirty years ago I carried a shoe box full of the roots to a farm I own in Ozark County, Missouri. From that shoe box I have set 300 acres. It will take this country. It will save the farmers in spite of themselves. It will choke out the cotton, overrun the fields. I had it set all along the roads and highways." He laughed uproariously. "It spead into the fields. It took the land. You see this 50 acre field? Twenty-five years ago it was a cotton field. But the Bermuda spread from the road. It took the field." Again he laughed, laughed so long and loud that I joined in with him.

"These farmers' wives fuss at me. They are afraid their men will get the Bermuda grass fever. They don't like it because it spreads from the roads into their gardens and flowers."

"What about row crops? You've got to have row crops," I said. Mr. Kelly's jovial face changed. He scowled at me. "Row crops," he shouted. "You don't need row crops with Bermuda. Row crops have caused this country to wash away."

"Other methods," snorted Mr. Kelly. "Yes, there are other methods, and compared to Bermuda none of them is worth a good cuss word. Bermuda is the only real soil saver."

"Have you tried other methods?" I asked.

"All I ever heard of—and quit them because Bermuda was better. You see that post there? I set that post 15 years ago 7 feet out of the ground. It is 2 feet high now. The sod has filled up 4 feet of soil. You see that ditch?" He pointed to a drain ditch alongside the road. "That ditch was over a horse's back ten years ago. It was eating out into the road and into the field on the other side. I set it in Bermuda. Look at it now. Look at it now," he said triumphantly.

I looked. The ditch was about 18 inches deep. Its walls and banks were matted with Bermuda and long fingers of grass were reaching toward each other from either side in its bottom.

"We have to plough that ditch every year or two to keep it from clogging up. And you talk to me about other methods."

We drove by pasture after pasture of Bermuda grass where fat cattle grazed. We drove over hill and dale, over rocky land, good land, thin land, bad land, and the Bermuda was thriving everywhere.

"I have lots of trouble getting these farmers to take care of the pastures. You see this farm here?" said Mr. Kelly. "Fifteen years ago I had it rented. It had been set in Bermuda grass in 1904 and needed ploughing badly. Well, he owed me 4,000 dollars and I had renewed the note twice, and I said, 'Well, if you don't plough that pasture up I won't renew your note.' The fellow went around to the other banks and tried to get some money, but failed, and so he came back and said, 'All right, you win.' He ploughed up the Bermuda and it helped it a lot, but it needs ploughing again."

"Have you developed any superior varieties of Bermuda?" I asked.

"Well, I've experimented a great deal. I've tried a great many varieties, but the kind that has been growing here the longest is the best and hardiest. It has become acclimated.

There is a plot of Bermuda near the old fort that is 104 years old. I talked to an old soldier in the early days who saw it set out in 1833. It is still doing fine. I have brought many other varieties here from many parts of the world. I've got varieties from Arizona and Australia, but it froze out. Bermuda's worst enemies are cold and shade. It will grow in rather open timber, though. Look at that." I stopped the car. Not far off there was a good stand of Bermuda growing among some red oak trees.

"Well, I should say there is another enemy and that is dog fennel. These farmers won't pasture their Bermuda enough and the dog fennel comes. To do well Bermuda ought to be pastured a good deal. There's not enough cattle in the country. Bermuda will support from three to five head of cattle to the acre. Show me another grass that will do that. Yet some of these farmers are afraid of it.

"But let me tell you about the time I went to Australia. Did you know that New Zealand was one of the richest countries in the world? Did you know that New Zealand exported more butter than any country in the world and that it is all on account of Bermuda? I was going over on the boat in 1904 to Australia and I got to talking with an Englishman who said he had a little ranch of 7,000 acres he had just sold for 200 dollars an acre. He said they raised Couch grass on it for pasture. Said it was the finest grass in the world. When we got across he took me out and showed me some of this Couch grass. What do you think it was? As fine Bermuda as ever you saw. But that Australian Bermuda isn't as good for this country as what grows here.

"Bermuda Grass Mitchell has developed some fine varieties. But none of them is any better than this grass around Fort Smith. Mitchell has done a lot, though. He got the Bermuda grass fever along with me and John Fields in the early days. We made speeches all over the country. And every time we wrote an article we harped on Bermuda. John Fields and I made a Bermuda compact in 1902. He was editor of the *Oklahoma Farm Journal*. He agreed never to publish an issue of the paper without an article on Bermuda. And he

carried out the agreement as long as he was editor. But we lost him," Mr. Kelly said, sadly. "He went in with the farm-loan people. That was a good many years before he died."

"I guess you have sold a lot of Bermuda roots," I said.

"Sell it. I should say not. I've never sold a single sprig. But I've given it way. I've given away thousands and thousands of sacks of the sod. They come here and dig it up free of charge.

"One of the chief obstacles to spreading the Bermuda grass light," went on Mr. Kelly, "has been prejudice. The foremost farmer in this country to-day has been saved by Bermuda grass almost against his will. That's Claude Hampton. Claude Hampton worked for me for nine years and I never could convert him to the Bermuda grass doctrine. Annie, his wife, said his mother hated the grass and I reckon Claude had a parental antipathy to it. Annie said if you showed Claude a sprig of Bermuda he would spit at it like a kitten does at a dog. Claude had a fine bottom farm, over 200 acres, and he wouldn't allow Bermuda on it. Well, in 1927 the great flood came and covered all his land with a layer of white sand from 6 inches to a foot deep.

"Claude came to me and said, 'Well, Mr. Kelly, I'm ruined. The water has ruined my land.'

"I said, 'Claude, why don't you set it in Bermuda?' But Claude just laughed. He had heard me harp on Bermuda so much.

"Well, the next thing I knew Claude had got some Bermuda seed from Arizona. You ever been in Yuma, Arizona? Did you know there was a seed mill there that has developed machinery that will separate alfafa seed from Bermuda seed? Well, anyway, Claude sowed his land in Bermuda in May and got a fine stand.

"The best way to start Bermuda though is from the roots. I use a manure spreader to scatter it and then turn it under with a turning plough."

While Mr. Kelly was talking we had been approaching the edge of the Arkansas River bottom. In front of us was a comfortable-looking farm house surrounded by a Bermuda grass lawn. The house was situated on a rise just above the bottom.

"Look at that Bermuda grass pavement," said Mr. Kelly. The Bermuda grass had almost covered the road in front of the house. "This is where Claude Hampton lives."

We got out and I met Hampton and he drove us down into the bottom. Before us stretched 200 acres of the finest Bermuda grass I ever saw. Most of it stood 12 inches high.

"How long will Bermuda live under water?" I asked Mr. Kelly.

"Well, I don't know. Never have known water to stand on it over four or five months. It always came out."

"In this pasture is about 100 acres," said Mr. Hampton. "I've got 125 head of cattle on the grass. You can see they haven't eaten a tenth of it, and they are as fat as butter."

We stopped near a grove of trees where a bunch of cattle were shading. They were as fat cattle as ever I saw.

"I don't feed 'em a thing the year round. They live on Bermuda through the winter," said Mr. Hampton.

"Did I tell you about the time I converted the packing house people to Bermuda?" asked Mr. Kelly. "Well, the packing house man travelled around the country looking for a place to locate. I had been talking pasture and cattle to him but he said this wouldn't make a cattle country. 'Your grass ideas are all right,' he said, 'but it would take too long.' 'Now look here,' I said, 'I want to show your something.' I took him down to this bottom about 9 o'clock one morning and it was 10 o'clock before he was ready to leave. He was converted all right, and that's how Fort Smith happened to get the packing house."

"I guess they might call you one of Mr. Kelly's disciples," I said to Mr. Hampton.

"I guess they might," said Mr. Hamton. "Mr. Kelly kept telling me to quit work. I just sit in the shade and watch the cattle get fat."

The second bottom near Hampton's house was set in Bermuda too—but part of it had grown up in weeds.

'Claude, how about ploughing this up?" said Mr. Kelly. "It would help the Bermuda."

"Well, you know you told me to quit work and I'm trying to follow your advice," said Claude.

Driving back to the house Mr. Kelly said, "I have spent 50 years carrying the Bermuda gospel. When I was a young man I decided to devote my life to Bermuda. And I have. Or most of it. I am 76 now."

Couch Grass.

(*Cynodon dactylon* Pers.).

This article constitutes part of a series entitled "SOWN PASTURES AND THEIR MANAGEMENT," by MR. C. W. WINDERS, B.Sc. Agr., Assistant Research Officer, Queensland Department of Agriculture, and has been extracted verbatim from the October, 1937, issue of the *Queensland Agricultural Journal.*—Acting Editor.

Origin and Distribution.—Couch grass is widely spread in Queensland as a pasture plant, as a lawn grass, and as a weed of gardens and cultivations. It is probably native to Australia, but is common also in many other countries. It is highly valued for grazing purposes in the Southern United States of America, where it is known as Bermuda grass, and in India, where the name Doub grass is given to it.

Description.—In habit couch grass is a perennial, low-growing grass which produces slender, creeping runners that may reach a length of several feet and which root at the joints. It possesses, in addition to surface runners, thin, underground, creeping stems. The habit of the grass varies considerably according to the nature of the soil and the climate experienced, but it seldom reaches a height of more than 12 inches. The slender flowering stems terminate in between two and five purplish spikes from 1 to 2 inches in length.

Climatic Requirements.—The chief growing period of couch grass is during the summer months. Growth is retarded by cold weather, and is checked almost entirely by severe frosts, but the plants are seldom killed by cold. The grass is extremely drought resistant, though it is not productive under dry conditions.

Soils.—Couch grass requires a fertile soil for its best development, but will grow on an extremely wide range of soil types, from beach sands to dry, alkali soils. It does best on fertile, light loams, particularly on alluvial flats.

Planting.—Flowering heads are produced in abundance during the warmer months of the year, but the heads shatter badly when the seed is formed, and commercial samples of seed often show a germination percentage of less than 30. Good seed, germinating as high as 92 per cent., is available at times, and should be used in preference to cheap, unreliable lines. From 5 to 8 lb. of good seed are sufficient to sow an acre. For planting small areas it is usually preferable to employ rootstock or stem cuttings if they are available, spacing them 18 inches apart in drills struck out at intervals of about 2 feet. Sowing or planting should be carried out during spring or summer.

Owing to its smothering action on most other pasture plants, couch grass is usually not employed in pasture mixtures, but sowings of the grass may be improved by the addition of a suitable legume. In coastal districts the common lespedeza (*Lespedeza striata*) mixes well with couch grass."

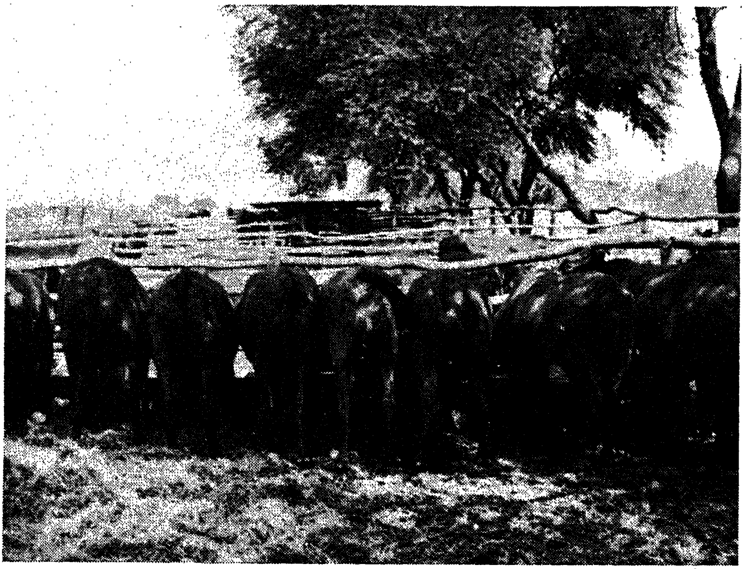
Management.—Couch grass pastures are fairly easy to manage, as they are not readily eaten out by stock. However, intermittent grazing is recommended in order to make the most efficient use of the pasture.

Conservation.—Owing to its relatively short growth, couch grass is seldom cut for hay or ensilage.

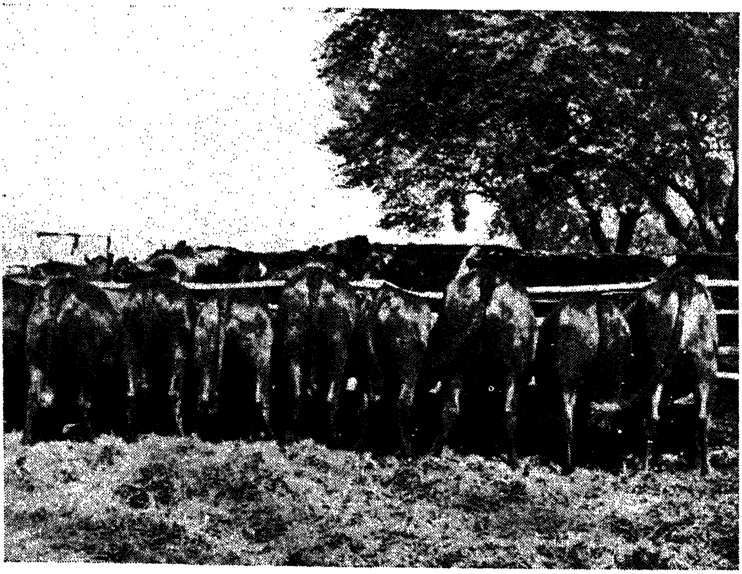
Feeding Value.—The feeding value of couch grass, particularly when growing on good quality soils, is excellent, and the palatability and digestibility of the grass render it a first-class grazing plant for all classes of stock.

Special Uses.—In addition to its usefulness as a pasture, couch grass may be employed for the fixation of sandy soils or of slopes subject to erosion, and also for green formation on aerodromes, lawns, golf links, etc.

Undesirable Features.—By virtue of its persistent habit couch grass is very troublesome when it invades cultivation areas.



Group I.—Bullocks receiving cowpea hay.



Group II.—Bullocks receiving sunnhemp hay.

The Feeding of Sunnhemp Hay

(*CROTALARIA JUNCEA*) AS COMPARED WITH COW-PEA HAY (*VIGNA CATJANG*) IN A FATTENING RATION FOR BULLOCKS.

By A. E. Romyn and R. H. Fitt.

Introduction.—The use of sunnhemp as a hay crop for feeding cattle has been increasing recently in the Colony. At one time it was thought to be poisonous to stock, but further experience has not shown this crop to be harmful and farmers are now making use of it quite widely as a legume hay in the feeding of cattle.

As far as is known Mr. W. B. Richards, Fort Victoria, was the first farmer in the Colony to test the value of this crop seriously as a feed for cattle. He worked in co-operation with the Chief Agriculturist of this Department, who subsequently carried out palatability trials with sunnhemp silage at the Salisbury Experiment Station and found it to be unpalatable to cattle. Trials have been carried out at the same Station to determine the effects of different rates of seeding on the yield of fodder.(1) McChlery has published data on the composition of sunnhemp at different stages of growth in relation to its value as a green manure crop, which show that sunnhemp has a high feeding value as a hay if cut just before the crop comes into flower.(2) Unpublished results from feeding trials carried out at the Rhodes Matopo Estate have shown that sunnhemp hay of fair quality was not eaten so readily as cow-pea hay, but was approximately equal to it for maintenance purposes for wintering dairy heifers. Husband found that sunnhemp hay, though eaten readily by young bullocks at the Pasture Research Station, Marandellas, when fed *ad lib* proved merely a maintenance ration. The hay used in this trial was of coarse quality.(3).

The feeding results obtained so far in this Colony are not conclusive, as in most cases the sunnhemp hay used was either inferior in quality or it was fed in amounts which were too limited to affect significantly the feeding value of the ration as a whole. It was therefore decided to carry out a further feeding trial at the Rhodes Matopo Estate to determine whether sunnhemp hay could replace cowpea hay in the ration for fattening bullocks.

Plan of the Experiment.—Twenty four-year-old Aberdeen Angus x Africander ranch steers were used in this experiment. They were of fair beef type and in good store condition when the trial started. They were divided into two similar groups as far as type and weight were concerned. Group 1 received a ration of maize meal, cowpea hay and maize silage. Group 2 received a ration of maize meal, sunnhemp hay and maize silage. The rations were the same except that Group 2 was fed sunnhemp hay instead of cowpea hay. The feeding trial started on the 20th July, 1937, and the cattle were fed for 80 days.

The cowpea hay and sunnhemp hay used were grown on the Estate. The sunnhemp—Somerset variety—was sown on the 1st February and reaped when 70 days old at an average height of 3 feet 6 inches. The plants were then in the early bud stage. The average yield of hay per acre was 3,016 lbs.

The cowpeas—New Era—were sown a little earlier (mid-January) and reaped early in April, when approximately 80 days old, being ten days longer in maturing than the sunnhemp. The cowpeas grew well and were quite free from any leaf disease. The plants were cut in the early pod stage and the yield was one ton of hay per acre. The analyses of the two hays are given in Table 1 below:—

	Cowpea Hay.	Sunnhemp Hay.
Moisture	7.6	6.18
Ash	8.8	8.6
Crude Protein	12.5	15.6
Ether Extract	2.2	2.3
Crude Fibre	35.5	30.4
Carbohydrates ... ... (by difference)	33.4	36.3

It will be noted from the analyses that the sunnhemp hay is somewhat higher in protein and somewhat lower in crude fibre than the cowpea hay.

Feeding of the Cattle.—The steers were fattened in ordinary pens which were well sheltered with thorn trees. Figures 1 and 2 illustrate the general layout of the pens. The concentrates, legume hay and silage were fed in two feeds daily—at 7 a.m. and 5 p.m. respectively. Veld hay of good quality was kept before the cattle all the time. The cattle were taken from their pens once daily for watering at a trough some 100 yards distant.

The average daily feed consumption of the steers amounted to approximately 12½ lbs. maize meal, 6 lbs. cowpea hay or sunnhemp hay, 8.26 lbs. of silage and 13.81 lbs. veld hay per head per day. The bullocks were started on a small ration of maize meal, approximately 2 lbs. per head per day, which was increased rapidly to a mamixum of 14 lbs. per day.

Experimental Data.—The steers were weighed on three consecutive days at the commencement of the experiment in order to obtain the average initial weights. During the experiment they were weighed at 28 day intervals. They were weighed on the two days prior to marketing and the average of these last two weights taken as the final weight.

The quality of feed consumed and the gains in liveweight of the two groups are given in Table 2.

From Table 2 it will be seen that there is no apparent difference in rate of gain in liveweight between the two groups or in the feeding value of the two rations. For practical purposes in this ration the sunnhemp hay has proved equal to cowpea hay. It will be noted that the sunnhemp hay group consumed a smaller amount of veld hay than the cowpea hay group. The slight difference is not considered to have affected the results. The bullocks fed well throughout with the exception of two in Group 2, which will be referred to later. The average daily rate of gain of both groups, 2.03 lbs., is considered satisfactory. The feed consumption per 100 lbs. of gain is comparatively large, but the steers were fed to a high grade of finish.

Table 2.—Feed Consumption and Gain in Liveweight.

	Average Daily Ration. lbs.					Average total consumption per steer. lbs.					Quantity of Feed Consumed and gain in Liveweight.			
	Maize Meal.	Cowpea Hay.	Sunnhemp Hay.	Maize Silage.	Veld Hay.	Maize Meal.	Cowpea Hay.	Sunnhemp Hay.	Maize Silage.	Veld Hay.	Average initial wt. per steer.	Average final wt. per steer.	Average total gain per steer.	Average daily gain per steer.
											lbs.	lbs.	lbs.	lbs.
Group 1—														
Cowpea Hay... ...	12.55	6.60	—	8.26	13.81	1,004	528	—	661	1,105	1,016	1,178	162	2.03
Group 2—														
Sunnhemp Hay	12.55	—	6.60	8.26	12.16	1,004	—	528	661	973	1,016	1,179	163	2.03

Feed Consumed per 100 lbs. gain in Liveweight.

	Maize Meal. lbs.	Cowpea Hay. lbs.	Sunnhemp Hay. lbs.	Silage. lbs.	Veld Hay. lbs.
Group 1...	620	326	—	408	682
Group 2...	616	—	324	406	597

Quality of the Carcases.—When fattened, the steers were sent by road, a distance of 20 miles, to the Rhodesian Export and Cold Storage Company in Bulawayo, where they were slaughtered and exported as chillers. After slaughter the carcases were graded and reported upon individually. In the cowpea group all 10 carcases were graded as "Imperial." In the sunnhemp group eight carcases were graded as "Imperial" and two as "Standard." It appears that the two steers graded "Standard" were bad feeders from the start. The general impression given by the carcases of the two groups was that the sunnhemp group, except for these two steers, was generally better finished and that the fat of this group was of a lighter colour than the cowpea group.

The average carcase weight in Group 1 was 675.3 lbs., giving a dressing percentage of 57.3. The average carcase weight in Group 2 was 675.0 lbs., giving a dressing percentage of 57.3 also. The dressing percentages are calculated on the farm weights and consequently are lower than the figure which would have been obtained had the cattle been weighed alive on arrival at the factory.

Conclusions.—Under the conditions of this feeding trial it would appear—

1. That sunnhemp hay (Somerset) when cut in the early bud stage and properly cured, is as palatable and valuable a feed as cowpea hay (New Era) in a standard ration in this Colony for fattening bullocks.

2. Sunnhemp, under certain conditions, will outyield cowpeas as a crop and, as it is an easier hay crop to handle, its more extensive use for the feeding of cattle in this Colony seems well justified.

3. It is important to cut the sunnhemp for hay before it becomes hard and woody. In this experiment the crop was cut at the early bud stage.

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The Fowl Tick.

(*ARGAS PERSICUS*).

By Poultry Division.

This is undoubtedly the worst insect that the poultry-keeper has to contend with, and is accountable for more deaths of fowls and greater loss to the poultry industry of the country than any other insect or disease. It is often wrongly termed the tampan which, although a tick, is quite different to the fowl tick, both in shape and size and also in colour. The tampan (or *inthodoros Moubata*) is not nearly as plentiful in Rhodesia as the fowl tick; it usually occurs in desert tracks, in the shade of trees and rocks, and in native huts, and is parasitic upon man, causing relapsing fever, or tick fever. The eggs are laid in the sand or hollows made in the ground by the females. The fowl tick on the other hand is, unfortunately very common, and widely distributed throughout South Africa; it is found in fowl houses, coops, etc., and under the bark of trees in close proximity to poultry. It is essentially a parasite of fowls, but is sometimes found on ducks, geese, turkeys and pigeons. It also causes a disease in fowls which, for want of a better name, is called *Spirochaetoses*, for the reason that it is the transmitting agent of the fowl *Spirochaete*, which is usually fatal to fowls. The female usually lays its eggs in the cracks and crevices of a fowl house or under the bark of trees.

There is not much doubt that the fowl tick was introduced into South Africa from India; it is also found in Australia and New Zealand, into which countries some say it was introduced from South Africa. It is unknown in cold, damp countries, but it thrives and multiplies rapidly in hot, dry climates. The majority of poultry keepers are quite unaware that these fowl ticks are present in their poultry houses. It behoves everyone to keep a constant watch for them, and to

use all means in their power to keep their birds and houses free from them, and if present, to get rid of them as soon as possible.

Methods of Detection.—The fowls are usually pale in face, the comb is pale and shrunken, they are listless, lay few or no eggs, or sicken rapidly and die. If small dark specks, similar to small ink blots, are seen around cracks or crevices in the wood, iron or brickwork of the houses or on the perches, it is practically a sure sign the fowl ticks are present. If the blade of a knife be inserted in the crack, blood will be found on it, and if the crack is enlarged the fowl tick will be found to be present. As the adults feed only at night, retiring to the cracks during the day, they will be seen after dark crawling about the walls or perches or feeding on the fowl.

Appearance of the Adult Fowl Tick.—Oval in shape and flat, with eight legs, two on each side near the head and two on each side of the middle of the body. In colour, when not engorged with blood, it is dark brown, with a distinct light brown margin round the body. After a long fast they have the appearance of small light brown withered leaves; when engorged with blood they lose their flattened appearance, and become a darker brown (almost a bluish brown) in colour.

Life Cycle of the Fowl Tick.—The adult female lays batches of eggs, in numbers varying from 20 to 100, at the rate of several a minute, in a crack or crevice of the house or coop or under the bark of a tree. These hatch in about three weeks, and we have the larvae, little bigger than a pin's head, and almost impossible to see with the naked eye. Under a magnifying glass they appear round in shape, of a grey translucent colour and with six legs. They immediately crawl about in search of a host, or are taken after dark on the backs of the adults. They remain on the fowl day and night from five to ten days, according to the temperature, feeding on the host and conveying the disease alluded to above. Having become engorged with blood, they become dark brown in colour and oval in shape; they drop off, hide in a crack or crevice, and moult into nymphs. The fact that they are so small as to be unnoticeable to the naked eye often leads the poultry keeper to imagine his birds are not affected. During the moult they grow a fourth pair of legs.

There are two nymphal stages; the first lasts about three weeks, the second about five weeks. They then moult into adults. During the two nymphal stages and the adult stage they leave the cracks after dark and return again before it is light, therefore in these stages they are never seen on the birds, except at night. They are rapid feeders, taking about $1\frac{1}{2}$ hours to become engorged. The adult females feed more plentifully than do the males, and usually once a month during the warm weather after each meal they lay a batch of eggs. From egg to egg stage lasts about ten months. The fowl tick can exist for a very long period without food, and larvae for seven to eight weeks, the nymphs a year, and the adults for two or three years. This accounts for the fact that if birds are put into a house in which there are fowl ticks, but which has been empty for two or three years, they will, immediately it is dark, be attacked. It is, therefore, imperative that all poultry keepers should thoroughly investigate the house before putting in new birds; a good method of ascertaining whether ticks are present is to put in at night two birds of little value, and later go in with a light and see if ticks are present.

Methods of Infection.—Adult ticks will gradually pass along fences or trees, and so from one poultry house to another. This is one of the usual methods of their spread in suburbs of towns. In Australia it is prohibited by law to allow these fowl ticks to infest houses, birds, trees, etc., or to sell poultry so infested, or even from infested premises. Such fowls, crates, etc., so infested are immediately destroyed, and the owner is liable to a heavy fine. In Rhodesia we have now a law dealing with the same matter, giving the right of inspection of premises. Another common cause of infection is by tick-infested coops, sacking, crates and fowls sent from one centre to another.

Cause of Death is Tick Fever (*Spirochoetosis*).—The cause of death is not due, as the majority of poultry keepers imagine, to weakness caused by loss of blood, although the loss of blood does weaken the bird and lowers its vitality, making it still more prone to the disease. The fowl tick, as mentioned above, is the host of an organism called the *Spirochaete* which, when the blood is being sucked, passes into the system of the fowl, causing the disease, the symptoms of which are prostra-

tion, ruffled feathers, high temperature, loss of appetite, thirst, rapid emaciation and diarrhoea of a greenish yellow colour. If the bird is treated at once by destroying the ticks, *i.e.*, the larvae, by dipping the fowl in a solution of warm water and two tablespoonfuls of Jeyes' fluid, Kerol or similar disinfectant, and removed to a clean quarters, it will probably recover, although as a rule the disease has developed to such an extent before it is noticed by the poultry keeper, and there are so many organisms in the blood that there is little hope of recovery; however, if recovery takes place the bird becomes immune. We thus find birds apparently well and in good health, although not as productive as they should be, in houses infested with these ticks, but if other birds which are not immune are introduced these immediately sicken and die. One often hears the remark, "I bought birds (it may be pure-bred or otherwise) from so and so, and soon after I had them they sickened and died, while my own birds seemed quite healthy." Of course, the seller is usually blamed, and his or her birds said to be delicate. The reason is obvious, and is one of the causes why pure-bred birds which probably have never been in the vicinity of a fowl tick in their lives are so often—and quite erroneously—by some people considered delicate.

Methods of Destroying the Fowl Tick.—System, perseverance and patience are necessary to get rid of this pest. Some recommend burning tick-infested houses. This is rather an expensive method if the house is of wood or brick; if of grass or straw or similar material, the loss is not great, and this procedure is recommended. If of iron (and, contrary to the usual idea, an iron house will harbour ticks under the overlapping sheets and similar hiding places) a quantity of straw can be placed inside and fired and the house made as hot as possible. In the case of brick or wooden houses, the best method is to use first a plumber's blow lamp, and direct the flame into all the cracks and crevices, then spray well into these a 20 per cent. solution of water, as hot as possible, and Jeyes' fluid or similar disinfectant, or a solution of paraffin emulsion. The same night put several birds into the house and go after dark with a light, and if any ticks are noticed, repeat both operations next day and each day until no ticks are discovered after dark. Coops, crates, nest-boxes, perches, etc., should be immersed for several days in a dipping tank

or solution as given for spraying or treated with a blow lamp. All trees infested should be cut down and fences, etc., removed. The ground on which the houses stand should be saturated with paraffin emulsion.

Paraffin Emulsion.—Shave ½ lb. of hard soap into one gallon of soft water and boil until soap is dissolved.

Remove from fire to a safe distance and immediately stir in two gallons of paraffin.

This thick creamy emulsion is a stock solution and will keep indefinitely.

To make up a spray for treating houses, perches, crates, etc., add one part by measure of the stock solution to four parts of boiling water. Mix well and apply as hot as possible.

Other disinfectants that can be used, although more expensive than the above, are:—

A 10 per cent. solution of carbolic acid; but great care must be, of course, used when employing this.

A 20 per cent. solution of Lysol.

A 10 per cent. solution of caustic potash or soda; care is required, too, in using this.

Preventive Measures.—Wood for wooden houses should be well painted before construction with solignum, carbolineum or similar preparation. All houses should be sprayed with paraffin emulsion every fortnight in hot weather and every month when it is cooler, and the spray forced well into the cracks or between any materials that overlap. All perches, nest-boxes, etc., should be movable. Strict cleanliness is a *sine qua non*. All new arrivals should be at once dipped. Coops and crates arriving from other quarters should be immersed in disinfectant solution for several days. Nearest neighbours should be urged to follow these precautions.

Vermin-proof Perches.—The most satisfactory method of preventing loss and damage from ticks in houses is to isolate all perches from ticks, whilst keeping down the ticks in the house as much as possible by means of the foregoing treatments.

Vermin-proof perches as they are called can be made to any design so long as they prevent ticks and the red mite from getting to them at night.

A simple type is that of a set of perches suspended on wires from the roof. Each wire passes through an inverted bottle neck or cigarette tin soldered on which is filled with old motor oil. No perches must touch the walls or any fittings and in this manner, if they are kept free from ticks, none can get to the birds at night. All birds must perch on the perches. This system sometimes causes loss from falls, broken eggs internally by the movement of the perches and is condemned by some. A more effective type is to support the cross pieces for the perches on bolts set in cement in the centre of old pipes, the tops of which are filled with oil and have a guard to prevent dirt and feathers from forming a bridge for the ticks. These are a very satisfactory type and can be thoroughly recommended. Oil cups must be kept constantly filled and free from dirt. Where dropping boards are in use the perches may be supported on legs which rest in oil cups on the boards.

These vermin-proof perches will protect birds that perch on them from attack from fowl ticks, red mite and bed bugs, all of which have similar nocturnal feeding habits and all attack poultry.

Keep the birds strong, healthy and vigorous and not over-fat. The reverse of this condition lowers their vitality and causes them to be more susceptible to the attacks of ticks. As long as ticks are present it is somewhat unsafe to keep poultry, and the financial loss is often great; certainly it means the difference between profit and loss. If each farmer and poultry keeper would do his share to eradicate the tick from his premises, we should soon see a vast improvement in the quantity and condition of the poultry of the country.

Alkalinity of Tobacco Seed Bed Soils.

By A. P. Taylor, M.A., B.Sc., Agricultural Chemist.

Apart from the usual difficulties experienced by the tobacco farmer in a dry season such as the present one, further trouble has manifested itself on certain seed-beds throughout the country and has recently been the subject of investigation by the Chemical Branch of the Department. This has occurred in former years, but not on such a widespread scale as recently.

Although it is customary with many farmers to select new seed-beds each year, there are quite a number who utilise the same site year after year, subjecting it on each occasion to the usual open fire sterilisation, with the subsequent digging in of the resultant wood ash, which in itself, when not in excess, is an excellent soil ameliorant, in addition to containing a certain measure of plant food. No harm is likely to accrue from this practice in a season of normal incidence of rain, because the early falls, which this year we have not received, assist the normal waterings in keeping the soil solution in a dilute state, and in preventing any undesirable accumulation of the alkaline salts emanating from the wood ash.

The case, however, is vastly different when no early rains have fallen, and the position is aggravated when the daily waterings supplied are highly charged with soluble salts, usually bicarbonates of magnesium and calcium, but occasionally with carbonate of soda. This is apt to occur on farms on or near the Great Dyke, but may also appear if the water supply is taken from pools from a partially dried up river bed. These pools have been subjected to intense evaporation for many months and have consequently become very concentrated. No one can have failed to notice the white lines on the banks of many partially dried up rivers, corresponding with successive periods of intense sun evaporation. These

deposits are almost invariably found to be lime and magnesium carbonates, which have come from the water as it receded.

In a season such as the present, therefore, two undesirable processes are liable to be indulged in, either singly or in combination. The first is the incorporation of too much wood ash in the seed-bed soil, the other is the application of water of an undesirable quality.

Germination of the seeds does not fail to take place, but very shortly after the little plants have shown themselves above the ground they are observed to wilt and die off, only some of the very hardiest surviving. Seed-bed soils upon which this had occurred have been submitted to the laboratory for investigation, and they did not all come from the Great Dyke area. Several came from light red soil areas in the vicinity of Salisbury where, to the best of our knowledge, the trouble had not appeared before. In most cases samples of the waters applied to the beds were also sent and analysed.

The most marked feature of the soils was their extreme alkalinity; this decreased rapidly with depth, until at 4 to 5 inches the reaction was strictly comparable with that of the surrounding untreated soil. Further, the percentage of soluble solids—and these were mainly calcium salts—contained in the water extracts of the soils, was much higher than that in a normal untreated soil.

Excessive alkalinity is at all times detrimental to plant growth, but is particularly harmful to young tender seedlings which, as every gardener knows, prefer a very light, sandy, slightly acid medium until they "get away." Not only is the alkalinity itself inimical to the young plants, but its effect on the physical structure of the soil is bad. In addition, the highly concentrated soil solution surrounding the tender rootlets tends to engender plasmolysis, which, in general terms, means that the rootlets lose their water, their cells becoming smaller and more or less limp. This, unless rectified, ultimately causes the death of the plant.

It is desirable, therefore, to ensure that too much wood ash remaining from the burning is not dug in, and this is specially important where the seed-bed site has been used

before. Much depends, of course, upon actually how much brushwood, etc., has been utilised for the sterilising process, but, as a general rule, there should not be a greater uniform depth of ash after the burning is finished and the ash raked over, than an average of ½ to 1 inch. This should be dug in to a depth of about 3 inches. If more ash is present, part should be scraped off until the above quantity only remains. With old seed-bed sites more still should be scraped off; the more wood ash incorporated in the soil, the more alkaline does the soil become, and the more concentrated will the soil solution be. It must always be remembered that a rich fertiliser mixture at a heavy rate has to be mixed with the wood ash or incorporated with it later, thus increasing greatly the concentration of salts in the soil.

Growers are advised to refer to articles entitled "Seed Beds" published in the *Rhodesia Agricultural Journal* in August and September, 1931, and reprinted in Bulletin 828, and to follow closely the instructions contained therein.

When the cause, or the partial cause, of the alkalinity in the soil is the watering with an alkaline water, this can be rectified very simply, and with little expense, by, peculiarly enough, adding more lime to the water. A sample of the water should be sent to the Agricultural Laboratory so that its lime and magnesia content may be ascertained, when instructions will be given as to how much lime it is necessary to add to soften the water. This should be done in a tank and it is better to have two tanks operating simultaneously. The requisite quantity of lime should be thoroughly stirred into the water, the whole allowed to settle, and the clear water from the top drawn off to water the seed-beds. The advantage of having two tanks is that one can be settling while the clear water in the other is being utilised. The addition of the lime in the quantity prescribed will have had the effect of rendering the magnesium and calcium salt insoluble, and the supernatant water will contain little or no magnesia or lime.

Notes on Witchweed.

By S. D. Timson, M.C., Assistant Agriculturist.

GREEN MANURING WITH TRAP CROPS.

Research into the manurial value of the trap crops commonly employed in the control of witchweed in this Colony has been pursued continually for the past eight years on the Agricultural Experiment Station, Salisbury.

For the first six years of this period the manurial value of two trap crops ploughed under in one season at a stage of maturity not greater than two months, was investigated. (Results published in *R.A.J.*, Vol. XXXI., No. 11, 1934.) It was shown that their manurial value on red clay loam soil free from witchweed, was nearly equivalent to that of one normal green manure crop of sunnhemp, and slightly greater than that of one green manure crop of sunflowers. Their manurial value was therefore found to be intermediate between that of one crop of sunnhemp and of sunflowers.

The trap crops which have been tested in this way are Sudan grass (*Sorghum sudanense*), Black Amber Cane and White Kaffir Corn.

Since it is not always desirable or necessary to plough under two traps in one season it was considered advisable to examine the manurial value of these crops under the same soil conditions when only one crop of each was ploughed under. An experiment to demonstrate this was laid down during the season 1934-35 when the traps and green manures were sown and ploughed under. Two crops of maize have since been grown. The results are shown in tabular form below.

SERIES 5.

Plots 1/16 *acre each. Design: Two randomised blocks of 6 treatments.*

Treatment in 1934-35 one crop of each variety ploughed under.	Yield of maize per acre 1935-36.	Yield of maize per acre 1936-37.	Average yield yield of maize 1935-37 in bags 200 lbs. per acre.
Dwarf Sunnhemp ...	20.00	11.72	15.86
Amber Cane	21.40	12.20	16.80
White Kaffir Corn ...	21.88	12.16	17.02
Wintersome	21.44	11.44	16.44
*Maize continuous ...	15.60	9.36	12.48

*Maize was grown in each of the three years 1934 to 1936-37.

In 1934-35 no fertiliser was applied to the plots, but in 1935-36 all plots received a dressing of 200 lbs. per acre of 20 per cent. superphosphate.

The dates of sowing the crops in 1934 were adjusted so that at the time of ploughing them under the sunnhemp was 96 days old, and the trap crops were all 80 days old.

Only five treatments are shown above, the sixth treatment having been discarded, since it is considered that the crop (common sunnhemp) had not been allowed sufficient time to make normal growth, and would therefore not form a true comparison with the other treatments.

In other series of experiments it has been shown that the dwarf sunnhemp has a manurial value in terms of the yield of maize following it of approximately three-quarters of a bag per acre less than the common sunnhemp, and this should be borne in mind when examining the results shown in the above table.

Owing to insufficient replication of the blocks in this experiment the results are not significant, and the differences between the various treatment effects may therefore be due to chance or variation of soil fertility.

Conclusions.—It is considered, however, that the evidence obtained indicates that the manurial value of the single trap crops is not greatly inferior, if at all, to that of a green manure crop of sunnhemp, under the conditions of the experiment when considered in conjunction with other experimental evidence.

Wintersome was included since it was thought possible that it might prove of use as a trap, but later experience indicates that it is a relatively poor host of witchweed, and it cannot therefore be recommended for that purpose.

TRAP-CROPPING.

The latest stage of maturity advisable for ploughing under the trap crop.

In previous articles and notes published in this Journal* the writer has emphasised the fact that trap crops must be ploughed under before they become too mature, owing to the danger of nitrogen starvation of the following crop being caused by their containing less than the minimum percentage of nitrogen, namely, about 1.7 to 1.8 per cent. on the dry matter. If the trap crop contains less than this percentage of nitrogen when turned under the fungi and bacteria, which rot down the crop in the soil, will be short of their requirements and will thereupon turn to the available nitrogen in the soil for their additional supplies, and in consequence the crop planted the following season may find a temporary shortage of available nitrogen in the soil, and thus suffer a more or less severe check in growth.

The nitrogen thus immobilised by the micro-organisms is eventually released into the soil in an available form, but this may be too late to be of use to the crop, since nitrogen is chiefly required by crops in the early portion of their life.

Serious nitrogen starvation has been observed in a number of cases where traps have been ploughed under at too mature a stage of growth in the past, and the evidence is usually unmistakable in the stunted growth, and the yellow colour of the leaves and stems of the maize or other non-leguminous crop.

*Vol. XXX., No. 1, 1933, *et al.*

With the co-operation of the Chemistry Division of this Department analyses of Sudan grass and White Kaffir Corn were carried out in 1932 on samples cut when these crops had made two months' growth.

These analyses showed that these crops contained just over the minimum percentage of nitrogen (1.7 to 1.8 per cent. on the dry matter) necessary to avoid the immobilisation of available soil nitrogen. The actual percentages found were 1.89 in the Sudan grass and 1.82 in the White Kaffir Corn.

It was considered, however, that further information concerning the nitrogen content of the various trap crops in use in the Colony at successive stages of growth might be of value to the farmer by assisting him to know the latest time at which it is advisable for him to plough under his traps, when he is forced by circumstances to delay it. It will also assist him under these circumstances to estimate to what extent he should apply correctives in the shape of nitrogenous fertilisers, and extra cultivation of the soil, or by delaying his date of planting of the following crop in the next season, in order to counteract shortage of available nitrogen in the soil.

With the co-operation of the Division of Chemistry therefore analyses were made of the five trap crops at present in use in this country at successive intervals of one week, with the results tabulated below.

It is necessary to point out that the minimum nitrogen content required by the micro-organisms concerned in the rotting of organic matter may alternatively be expressed in the form of the ratio of carbon to nitrogen present. Russell* states that "if the ratio of carbon to nitrogen in the crop is more than 20, the organisms effecting the decomposition may require more nitrogen than is supplied by the crop."

Jensen† gives the maximum ratio as one part of nitrogen to 20-25 parts of carbon in a neutral soil, and 13-18 parts when the soil was acid.

*Russell: Farmers' Guide to Agricultural Research in 1931, p. 177.

†Jensen: Journal of Agric. Science, 1929, Vol. 19, p. 71.

In the following tables the ratio of carbon to nitrogen in the top-growth (cut at ground level) of the crops is given at successive intervals of one week.

No. of days from germination.	38 days	45 days	52 days	59 days	66 days	73 days	80 days
Sudan Grass	12.3	13.8	14.6*	24.7	25.1	38.9	35.8
Amber Cane	9.9	11.6	11.4	16.7	18.1	21.9*	23.3
White Kaffir Corn	11.5	16.0	14.6	21.7*	30.1	36.2	47.7
Munga	9.2	10.8	10.5	11.4	17.5*	26.5	26.9

No. of days from germination.	54 days	61 days	68 days	75 days	82 days	89 days	96 days	103 days	107 days
‡Rhodesian Sudan grass (*Sorghum arundinaceum*)	10.5	12.0	11.9	11.2	16.3	20.5	15.3	20.4*	25.0

‡At the first sowing a poor germination of this grass was obtained and it was therefore re-sown at a later date.

The first series of sowings germinated on 12.12.36. The Rhodesian Sudan grass was re-sown on the 23.12.36 and germinated on the 31.12.36. It is possible therefore that the results of the analyses of Rhodesian Sudan grass are not truly comparable with those of the other trap crops, owing to the climatic conditions varying at the successive stages of growth from those under which the other crops grew.

As a measure of safety it is considered advisable that the ratio 20:1 should be taken as the widest one permissible to ensure that no available nitrogen is taken from the soil during decomposition of the crop, and in the above tables the stage at which each crop most nearly approaches this ratio is indicated by a "star."

It will be seen that the various crops show a wide variation in the stage of growth at which they attained the ratio of 20:1, and this probably in part explains the conflicting reports from farmers regarding the effects they have observed of ploughing under their trap crops when they have been forced to exceed the time limit hitherto advised by the writer of eight weeks from germination. For instance, Rhodesian

Sudan grass had a "safe" ratio at 103 days from germination, whereas the annual Sudan grass reached the "safe" ratio in a few days over the 52 days.

It will be seen that these results confirm the original analyses of Sudan grass and Kaffir Corn made in 1932, when it was found that these crops had approximately reached the "safe" nitrogen content in two months.

One point of considerable interest is that these analyses indicate that Rhodesian Sudan grass is "safe" to plough under for a very much longer period than the other trap crops, namely, approximately 30 days longer than its nearest competitor, Amber Cane, and 51 days longer than annual Sudan grass. This is a further considerable advantage to be obtained by the use of this crop for trapping witchweed, in addition to those already claimed for it in the article on witchweed published in the November, 1936, issue of this Journal.

This work is being repeated, as it is desirable to have information regarding the seasonal effect on the stage of growth at which the carbon/nitrogen ratio of these crops reaches a "safe" limit.

Trap-cropping: *Rhodesian Sudan Grass recommended.*

The further experience of this crop as a trap for witchweed obtained during the past season (1936-37) confirms the opinions concerning it expressed in the November, 1936, issue of this Journal, and as already mentioned above a further strong argument in favour of its use to the exclusion of the other traps so far employed, is that it appears much less likely to bring about nitrogen starvation of a following crop if for any reason the farmer is forced to delay ploughing it under.

The writer now feels justified in recommending the use of this trap in preference to all others so far tested.

Trap-cropping in General.—The writer is still convinced after another year's observation, and as a result of farmers' further experiences as reported to him, that the judicious employment of this method of witchweed control offers the most rapid and economically effective means of eradicating the pest; in proper combination, of course, with mechanical and hand cultivation.

The considerable body of evidence resulting from the research carried out by this Department over the past eight years, goes to prove that the trap crops in common use are very nearly as effective as sunnhemp as a green manure, and rather more effective than sunflowers, on soil free from witchweed.

On soil infested with witchweed, the application of the phosphatic fertiliser (which would normally be applied to the maize crop following it) to the trap crop is advised, since it will enable it to make good growth and so assist it to perform its additional function as a green manure. This fertiliser will again be available in the following year for the use of the maize crop.

Those farmers who are experiencing difficulty in controlling the pest by hand and machine cultivation, are therefore again strongly advised to replace the green manure crop in their rotation by a trap crop of Rhodesian Sudan grass, until they are able easily to control the pest by cultivation alone.

The alternative methods for employing trap crops have been discussed in previous articles appearing in this Journal (November, 1934, November, 1936, and November, 1937), and those readers interested in the matter are referred to them for suggestions, which may assist them to fit the practice into their particular farm organisation.

Munga as a Trap Crop.—This crop is still being accused, and in the writer's opinion and that of a number of skilled and observant farmers, quite wrongly, of bringing witchweed to maturity. In those cases which the writer has been able to investigate he has always found ample explanation of the presence of mature witchweed plants in the fact that a thin stand of munga has allowed wild grasses to grow and germinate the parasite.

As already pointed out, this is a danger of the use of munga, and this added to the fact that it is probably only half as efficient as our best traps in germinating witchweed, makes it advisable only to employ it as a trap crop under special circumstances.

Those farmers who have found the crop useful will be interested to learn that a bird-proof strain has been developed

by selection by the Native Affairs Department. This strain was exhibited on the last Salisbury Agricultural Show. It possesses long stiff awns on the seed head, which prevent birds extracting the grain.

The Spread of Witchweed by Stock.—The valuable investigations into the part played by stock in the distribution of seed of the parasite carried out by Mr. Farquhar, and reported in the article by him published in the July, 1937, issue of the Journal, indicate that cattle (working oxen in particular) may be an instrument of major importance in the spread of the parasite, and our thanks are due to him for giving the matter prominence.

It is clear, however, that the degree of importance to be attached to this method of distribution depends directly on the extent to which cattle actually eat the parasite. This will naturally depend first on the actual concentration of the parasite in the veld; but at present we have little information on the question of whether cattle eat the witchweed merely by accident whilst grazing grass amongst which it is growing, or whether they actually seek it out and show a preference for it, perhaps because it has a high mineral content, and therefore a salty flavour which attracts them owing to a mineral deficiency in the veld grasses. Mr. Farquhar found that two of his oxen ate witchweed plants readily, but we cannot conclude from this alone that in general cattle normally show a definite partiality for the weed, and are attracted to it in the veld.

Evidence Wanted from Farmers.—This is a question of great importance when considering the measures to be adopted in order to control the spread of the parasite by cattle, and until it is answered the writer does not feel able to recommend unreservedly the destruction of witchweed in the veld. *He therefore appeals to farmers to carefully study this question on their own farms, and to let him have the results of their observations.* Normally the parasite is in flower on the veld at the end of December or the beginning of January, but early heavy rains in October may advance the date of its first flowering, of course, and a late arrival of the seasonal rains may retard it. If farmers will carefully instruct their herd boys in what to watch for, and then themselves check up the

evidence, and forward it to the writer, then by the end of this season a sufficient weight of evidence should be available to decide the question.

It seems clear that in the case of veld pasture, which is generally and severely infested with the parasite, that there is a grave danger from this source of infestation or re-infestation of the cultivated land, and that working oxen should not be grazed on such areas when actually at work on the land, if this can be avoided, whilst the parasite is flowering and seeding. Where the whole pasture area is thus infested farmers can be advised to take in hand at once the work of controlling the parasite on a sufficient area of their veld to supply clean grazing for their working cattle during the danger period.

Farmers are also advised to make a careful survey in January and February of their pastures so as to determine to what extent these are infested, and where they are not generally infested to mark those areas which are more or less free from the parasite for the use of the working oxen from January to May, when they are working on the land.

Again, it is clear that where a maize field has been stooked and it is infested with witchweed in flower, and seeding, it will be dangerous to take oxen straight from ploughing this to a comparatively clean field, or to clean pasture. It is obvious, of course, that the control of the witchweed should be carried on right up to the time of ploughing or until the witchweed is killed by the frost, and the danger of its spread by oxen thus avoided. This, unfortunately, is not always possible, and where the danger exists it might be avoided by making a pause of at least a day, and preferably two days, before commencing to plough clean land.

Another step which can be advised is the protection by storm drains of pastures from infestation from hills lying above them by the seed carried by storm water. Another important source of infestation is the spilling of seed in storm water from infested maize fields protected by contour ridges, and such points will require special attention when clearing pastures from the parasite, and as far as possible the latter must be prevented from seeding in such maize fields.

The writer considers that it is probable that the most suitable method for destruction of the parasite in pastures will prove to be by spraying the plants with a 1½ to 2 per cent. solution (1½ to 2 lbs. in 10 gallons of water) of sodium chlorate. Small pneumatic pressure spray pumps with a trigger type control are on the market and sold at a moderate price (about 42s.), which are very suitable. The advantage of this method of control over hand cultivation is that the parasite is killed outright by spraying and does not grow afresh from the same roots or stem.

Where there is any concentration of the parasite such as occurs in hollows or at points where contour ridges spill seed on to the veld, free use of the spray pump will be necessary, and it will be necessary to keep cattle from such areas until rain has fallen and washed the surplus sodium chlorate from the foliage. Sodium chlorate is only poisonous to stock when eaten in considerable quantities, and light spraying of isolated plants or small patches with the solution strength advised will not be a source of danger to stock. A fine spray is required and just sufficient should be applied to just moisten the leaves of the witchweed.

Where it is possible, new virgin land might be cleared with advantage, and an equivalent acreage of infested land sown with Rhodes grass to provide grazing free from witchweed. A heavy rate of seeding of the grass would be desirable in order to exclude other grasses as far as possible, and at least 8 lbs. per acre of good imported seed would be advisable. When sown on heavily infested soil in the Mazoe Valley it has been found that Rhodes grass brings to the surface practically no witchweed; and it is probable that the few plants observed were germinated by wild grasses, since in the Union Saunders states that Rhodes grass brought no witchweed to the surface when established on heavily infested soil.

Where no virgin land is available, farmers are advised to consider the laying down of a sufficient area of their cultivated land under Rhodes grass to supply clean grazing for their working oxen during the danger period from January to May. One acre per beast should be sufficient allowance if the grazing is well managed, and a dressing of 5 tons per acre

of compost applied every third or fourth year. When made from sunnhemp or sunflowers and kaffir beans, on the lines suggested in the November issue of this Journal, compost should cost at most 2s. per ton to make.

Woolly Finger grass can also be recommended for this purpose and is preferable to Rhodes grass on sandy soils, but large areas cannot be established quickly, except at an excessive cost per acre.

Since the soil must have a very fine tilth, much finer than required for the maize crop, when establishing Rhodes grass it is advisable first to protect the soil from erosion by contour ridging.

It is not possible here to deal in detail with all the problems that arise in designing proper control of the spread of witchweed by the working oxen, but it is hoped that sufficient has been said above to indicate the broad lines on which it is considered that it should proceed where a farmer has satisfied himself that it is advisable.

Where farmers are in doubt as to the methods they should employ, this Department will be glad to advise them and give any assistance in its power.

Small Earthen Storage Dams.

By the Irrigation Division.

1.—GENERAL.

Factors Determining Suitability of Sites.—The storage of water serves many useful and essential purposes among which may be mentioned:—

(*a*) The holding up of flood water for a limited period with the object of improving underground supplies and the stabilising of stream flow.

(*b*) The storage of the small flow available in a stream or furrow for periods varying from twelve hours to several days with the object of obtaining a large flow for a limited period and thus enabling economical irrigation of the area commanded.

(*c*) The storage of flood water with the object of providing supplies for the watering of stock.

(*d*) The storage of flood water for the purposes of irrigation during the dry season.

In all these cases if a site, which complies with certain conditions is available, the cheapest form of structure is an earthen storage dam which merely involves the construction of an earthen embankment across a natural depression and the excavation of a spillway channel on one or both flanks to enable flood water to be disposed of without danger of the embankment being overtopped.

The following are the most important factors to be considered when determining if a site is suitable for an earthen storage dam:—

(1) Existence of impervious foundations for the embankment.

(2) Presence of suitable material in the vicinity for the construction of the embankment and core wall.

(3) Presence of natural features at the site permitting of the construction of an efficient spillway channel at a reasonable cost.

(4) Capacity of the impounding basin in relation to an economical height of wall.

(5) The probable minimum run off from the catchment area in relation to the capacity of the impounding basin.

(6) The area of land suitable for irrigation within a reasonable distance of the dam site.

(7) The economical aspect of the scheme, *i.e.*, the total cost of the storage work in relation to the area of land irrigable.

All these factors are of prime importance for whatever purpose the dam is required, except that if it is merely being constructed for the purpose of checking flood run-off and promoting the absorption of water by the soil, the existence of impervious foundations is not necessary.

Engineering advice is available, on application to the Irrigation Division, on the selection of sites, the design of a suitable work and its estimated cost, but much of the engineer's time is saved if the farmer carries out a few preliminary investigations and selects what he regards as the most suitable sites.

In order to enable the farmer to do this the following information is given for his guidance before dealing with details of construction.

Foundations.—The nature of the underlying formation should always be proved by sinking trial pits along the centre line of the proposed dam. These trial pits should be carried down through the underlying beds of sand or gravel into compact soil or clay, or on to solid rock.

If clay or solid rock is encountered at a reasonable depth the site is a suitable one from the point of view of foundations, as these foundations are practically impervious.

In the case of clay it is important, however, that the trial pit should be continued two or three feet into the clay to

ensure that it is a continuous bed and not merely a thin layer overlying a stratum of sand or gravel, as will be found to be the case in many of our stream channels. If a first-class impervious formation such as clay or rock is not encountered in the trial pits the site need not necessarily be condemned, as compact soil, which does not permit of easy free drainage of water is also suitable, provided the core or cut-off trench is carried down to a sufficient depth. Therefore if soil only is encountered the trial pits should be excavated to a depth equal to two-thirds of the full supply level of the water in the dam at that point, *e.g.*, if 12 foot depth of water is to be stored above ground level at the trial pit the pit should be excavated to a depth of at least 8 feet. The types of foundations which, if they extend to any depth, are unsuitable for an earthen storage dam are gravel, rubble, sand, or boulders.

Catchment Area.—By catchment area is meant the extent of country from which the drainage would naturally flow into the proposed dam. The catchment area available is of importance in determining whether a proposed site is a suitable one, as if the catchment area is small there may not normally be sufficient flood run-off for the purpose required, and if the catchment area is large the provision of a spillway of adequate dimensions may render the cost prohibitive and the site, therefore, an unsuitable one for an earthen storage dam.

In the case of dams which are required for irrigation purposes and are to be located on streams which have practically no flow after the end of the rainy season, the question of the probable storm run-off from the catchment area in years of normal and under-normal rainfall is of prime importance.

The flood run-off will, of course, differ in different types of catchment areas and the factors influencing the run-off in the order of their priority are:—

(1) Distribution and amount of the rainfall.

(2) Average slope of the area. In general the steeper the slope the greater the run-off.

(3) Nature of the area, *i.e.*, whether it is rugged and bare, or covered with deep soil either bush-covered or well-grassed, etc.

(4) Nature of the geological strata underlying the area and whether it is permeable or impermeable to water.

(5) Size of the catchment area.

The following table gives a conservative estimate of the probable flood run-off in acre-feet per square mile of catchment from two catchments which are typical of the general conditions in this Colony.

An "acre-foot" is a convenient unit for storage of water for irrigation purposes and means the volume of water necessary to cover an acre to the depth of one foot.

As an acre-foot is approximately equivalent to 250,000 gallons the figures in the following table can be converted into millions of gallons by dividing the quantity expressed in acre-feet by 4.

Catchment "A" is a typical high-veld Rhodesian catchment, *i.e.*, a gentle sloping grass and bush-covered granite veld catchment. Catchment "B" is a typical middle-veld Rhodesian catchment, *i.e.*, a steeply-sloping, heavily grassed, mixed granite and schist formation, with numerous kopjes.

TABLE 1.

Flood Run-off from two typical Rhodesian Catchments.

Seasonal rainfall total inches.	Run-off in acre-feet per square mile. Catchment "A." average.	minimum.	Catchment "B." average.	minimum.
12	19.20	7.24	26.72	14.19
14	24.70	8.80	33.39	16.96
16	30.93	10.45	38.83	19.57
18	40.16	12.80	43.20	23.52
20	53.23	15.68	54.93	31.31
22	75.63	23.25	63.57	38.45
24	107.25	26.18	79.68	49.49
26	155.14	61.17	99.30	59.57
28	208.27	94.56	118.19	74.08
30	265.65	127.10	138.93	89.23
32	312.75	162.88	163.30	116.21

This table can be utilised as follows for roughly determining the size of catchment area that should be available above any selected site if it is to be regarded as a suitable one for the irrigation of a specified area of land.

If the stream is one in which there is very little normal flow after the rains have ceased it can be accepted that 4 acre-feet of water must be stored for the irrigation of each acre of land in order to provide for the inevitable evaporation and absorption losses in the dam.

If, therefore, it is desired to store water for the irrigation of 25 acres the catchment area above any suitable dam site must be capable of yielding at least 100 acre-feet of flood run-off in the great majority of years to make the proposition a feasible one.

In order to determine what run-off can be relied on it is safe to take the average run-off figure in Table 1 shown against a season's rainfall total of two-thirds of the average seasonal rainfall (October to April) for the locality. The reason is that on examining our rainfall records it is found that it is only on very rare occasions that the rainfall at a station is less than two-thirds of the average rainfall at that station.

If therefore the catchment under consideration is of the "A" type with an average seasonal rainfall of 27 inches it can be accepted that a seasonal rainfall of 18 inches can be depended on, and Table 1 shows that the reliable run-off will be 40.16 acre-feet per square mile of catchment and on rare occasions may fall as low as 12.80 acre-feet per square mile of catchment.

To provide sufficient flood run-off for the normal irrigation of 25 acres from a catchment of this type therefore necessitates a catchment area at least 2½ square miles in extent, and on rare occasions there may be only sufficient water for the irrigation of 8 acres. The shortage of water in certain seasons is not of prime importance unless the irrigation of a permanent crop such as citrus is under consideration.

If the stream has a sufficiently well-sustained normal flow after the rainy season to make up for the probable evaporation and absorption losses in the dam the storage required can be reduced to 2½ acre-feet per acre irrigated, and under these conditions a storage of only 62½ acre-feet would be required for the irrigation of 25 acres, and this would be produced by a catchment only 1½ square miles in extent, which has an assured rainfall of 18 inches.

It is desirable therefore, if possible, to locate these dams on streams which at least have a small flow during a portion of the dry season. Assuming that the dam will have a mean surface area of 10 acres during the dry season it may be stated that the stream should have a flow of 1/10 cubic feet/second to make up for the probable evaporation losses in the dam. Alternatively, this flow, although insufficient for irrigation direct, could be conserved in a smaller dam for a period of a few days at a time when it could be utilised for the irrigation of 10 acres.

It is important, therefore, that whenever possible information should be obtained as to the dry season flow in streams in which it is proposed to construct dams.

Particulars as to the methods of gauging small stream flows are contained in Bulletin No. 632.

Flood Spillway.—Another important factor in determining whether the site is a suitable one is the existence of natural features which permit of a spillway being constructed at reasonable cost which will be of adequate dimensions to pass the maximum flood that can be expected from the catchment area above the dam. It must be emphasised that the provision of a spillway channel of ample capacity to pass extreme floods, without danger of the earthen embankment being overtopped, is of the utmost importance, as 99 per cent. of the failure of earthen dams by breaching have been due to the construction of spillway channels of insufficient capacity to deal with extreme conditions. Any attempt to save costs by reducing the size of the spillway is therefore merely asking for trouble, and the only sound method to keep down expenditure is to try to find suitable sites on streams which have a catchment area of sufficient extent to provide the flood run-off for the normal requirements as detailed in the preceding paragraph and where catchment areas are not so unduly large as to necessitate the construction of a very wide spillway, unless such spillway is naturally available without involving costs for excavation. If the spillway is in soft formation it is desirable that the depth of water flowing through it in the normal flood should not exceed 3 feet, as any greater depth than this would necessitate the construction of expensive works to prevent scouring of the channel.

The factors which determine the probable maximum flood run-off from any catchment are its size, its shape and its general slope and the nature of the surface cover.

The worst conditions will occur when the catchment is saturated with previous rains and a heavy intense storm occurs which is distributed over the whole of the catchment and is of sufficiently long duration to enable the flood water from the extreme limits of the catchment to reach the dam before the rain has ceased there.

The slope and nature of cover on the catchment will determine the speed at which the flood water will travel and the size and shape of the catchment determines the maximum distances which have to be traversed by the flood water to reach the dam. For the same sized catchment higher floods will normally be experienced from one in which its length and breadth are about equal, than from one which is long and narrow.

For example, if we have a catchment four square miles in extent and its length is equal to its breadth, the extreme distance the flood water will have to travel before reaching the spillway is only two miles, whereas if this catchment has only a mean breadth of half a mile the flood water would have to travel an extreme length of eight miles.

The "gathering time" of a catchment in hours is:—

$$\frac{\textit{Area of Catchment in Square Miles.}}{\textit{Mean breadth of catchment miles} \times \textit{speed of travel of flood water in miles per hour.}}$$

The speeds of travel of the flood water in miles per hour may be assumed as follows:—

(*a*) Moderately sloping grassed catchment 2 m.p.h.
(*b*) Steeply sloping grassed catchment ... 3 m.p.h.
(*c*) Bare hilly catchment... ... ... 4 m.p.h.

For small catchments up to five miles in extent it can be accepted that the following will be the hourly rates of precipitation of the most intense storms which can be expected to be distributed over the whole catchment and persist for the period of the gathering time.

TABLE 2.

Extreme Rates of Precipitation on Catchments up to five miles in extent.

Gathering time in hours.	Average rate of precipitation inches per hour.	Total rainfall in inches on catchment during period of gathering time.
½	8.0	4.0
1	6.0	6.0
2	3.75	7.5
3	2.67	8.0
4	2.12	8.5

The relatively worst conditions that may occur will be in small catchments with a gathering time of less than an hour.

For larger catchment of about fifty square miles in extent the following are the worst rainfall conditions that might occur and persist for the period of the gathering time.

TABLE 3.

Gathering time in hours.	Average rate of precipitation inches per hour.	Total rainfall in inches on catchment during period of gathering time.
2	2.5	5.0
3	2.17	6.5
4	1.75	7.0
5	1.5	7.5
6	1.3	7.8
8	1.0	8.0

For intermediate catchments between 5 and 50 miles interpolations from these tables will enable safe assumptions to be made as to the extreme average rate of precipitation that is likely to occur over the whole catchment.

In the following table is shown the widths of spillway that are necessary for safely disposing of floods from different sized catchment areas in this Colony on the assumption that the maximum run-off will be 40 per cent. of the rainfall.

These widths are calculated on the assumption that the crest of the main embankment will be constructed to a sufficiently high level to permit of an additional two foot depth of discharge through the spillway over and above the normal depth of three feet in order to pass the abnormal floods when the extreme rainfall conditions defined in the above table occur, *i.e., the crest of the dam should in all cases be at least five feet above the spillway level.*

The discharge of the spillway channels are based on the calculations in Appendix (2) of Professional Paper No. 8 issued by the Irrigation Department of the Union of South Africa.

TABLE 4.

Safe Spillway widths for various Catchments.

Catchment area in square miles.	Gathering time in hours.	Width of spillway in feet.	Ordinary flood discharge with 3 foot depth. Cusecs.	Abnormal flood discharge with 5 foot depth. Cusecs.
1.	½	64	908	2,050
	1	48	680	1,535
	2	30	425	960
2.	½	128	1,816	4,010
	1	96	1,360	3,070
	2	60	850	1,920
	3	43	610	1,365
5.	1	242	3,436	7,675
	2	151	2,144	4,800
	3	108	1,534	3.410
	4	85	1,205	2,710
10.	1	404	5,735	12,800
	2	282	4,005	8,960
	3	210	2,980	6,655
	4	160	2,270	5,120
	5	130	1,845	4,095
15.	2	409	5,810	12,960
	3	309	4,390	9,790
	4	238	3,380	7,565
	5	192	2,725	6,105

Catchment area in square miles.	Gathering time in hours.	Width of spillway in feet.	Ordinary flood discharge with 3 foot depth. Cusecs.	Abnormal flood discharge with 5 foot depth. Cusecs.
20.	2	525	7,455	16,640
	3	404	5,735	12,800
	4	313	4,445	9,930
	5	255	3,620	8,090
25.	2	631	8,960	20,000
	3	494	7,015	15,680
	4	383	5,440	12,160
	5	315	4,475	9,985
	6	269	3,820	8,510
30.	2	727	10,325	23,040
	3	581	8,250	18,430
	4	453	6,430	14,360
	5	375	5,325	11,905
	6	320	4,545	10,135
	7	273	3,875	8,680
40.	2	888	12,610	28,160
	3	733	10,410	23,245
	4	584	8,290	18,535
	5	490	6,960	15,565
	6	420	5,965	13,310
	7	365	5,185	11,570
	8	323	4,585	10,240
50.	2	1,010	14,340	32,000
	3	876	12,440	27,775
	4	707	10,040	22,400
	5	606	8,605	19,200
	6	525	7,455	16,640
	7	456	6,475	14,465
	8	404	5,735	12,800

A glance at these tables will show how great the variations are for safe spillway widths for the same sized catchment, but which differ in shape and nature of cover, *e.g.*, a catchment five square miles in extent may require a spillway as wide as 242 feet or as narrow as 85 feet.

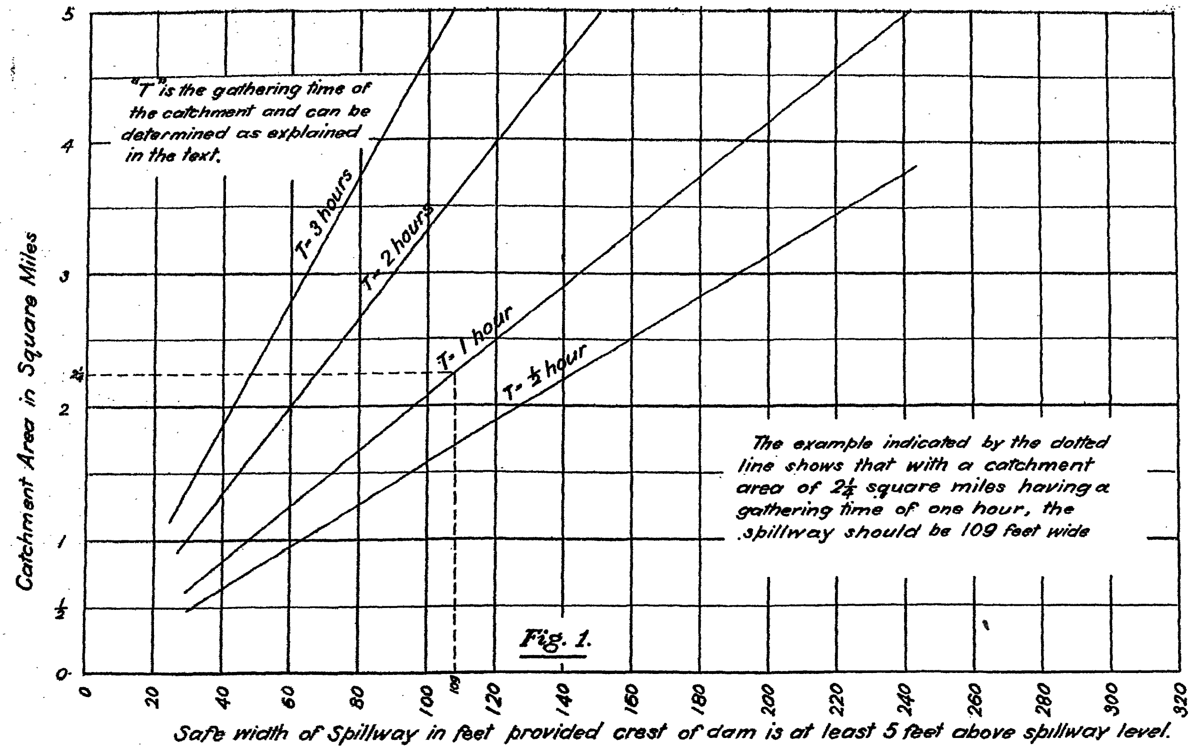

"T" is the gathering time of the catchment and can be determined as explained in the text.
T- 3 hours
T- 2 hours
T- 1 hour
T- ½ hour
The example indicated by the dotted line shows that with a catchment area of 2¼ square miles having a gathering time of one hour, the spillway should be 109 feet wide
Catchment Area in Square Miles
Safe width of Spillway in feet provided crest of dam is at least 5 feet above spillway level.
0
½
1
2
2¼
3
4
5
0
20
40
60
80
100
109
120
140
160
180
200
220
240
260
280
300
320

Fig. 1.

The larger spillway will be required if the catchment is four miles in length and is steep and rocky, while the narrow spillway will only be necessary if the catchment is eight miles in length and is gently sloping and covered with grass or sand. As reliable approximations to these factors can be readily made it is obvious that they should be taken into consideration when deciding on a safe spillway width at any particular site.

From figures Nos. 1 and 2 the safe spillway widths can be derived for any sized catchment area up to 50 miles in extent under all ranges of ordinary practical conditions—in all cases the crest of the dam should be at least five feet above spillway level and preferably should be constructed to six foot above spillway level to provide additional security against overtopping by the exceptionally high flood.

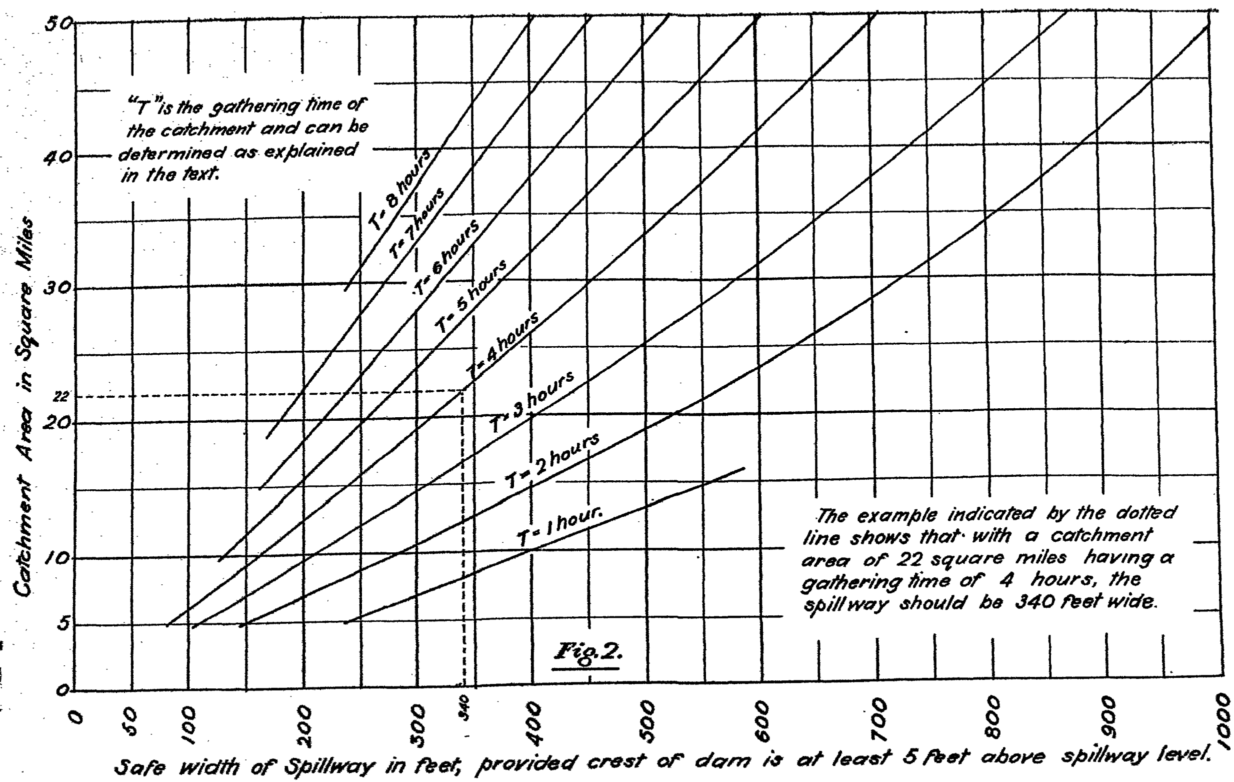
These tables also show that very extensive spillways are required for catchments over five square miles in extent, and it is desirable therefore to attempt to locate suitable sites on streams which have catchment areas between one and five square miles in extent.

From the spillway point of view the most suitable sites are those which have a reasonably level stretch of land of the requisite width at an elevation between 10 and 20 feet above the stream bed at the dam site.

Capacity of Impounding Basin.—The final factor determining whether the site is a suitable one is whether a sufficient quantity of water can be stored with an economical and reasonable height and length of embankment. In the case of dams for the purpose of supplying water for stock the actual quantity of water stored is not of so much importance but a sufficient depth of water should be stored to enable water to be available throughout the dry season after allowing for the depth lost by evaporation and seepage.

In the case of dams for irrigation purposes, however, the quantity and depth of water stored is of prime importance, as this determines the area of land that can be irrigated.

The following table will emphasise how serious the evaporation losses are from free water surfaces in this Colony.



"T" is the gathering time of the catchment and can be determined as explained in the text.
T = 8 hours
T = 7 hours
T = 6 hours
T = 5 hours
T = 4 hours
T = 3 hours
T = 2 hours
T = 1 hour.
The example indicated by the dotted line shows that with a catchment area of 22 square miles having a gathering time of 4 hours, the spillway should be 340 feet wide.
Catchment Area in Square Miles
0
5
10
20
22
30
40
50
0
50
100
200
300
340
400
500
600
700
800
900
1000
Safe width of Spillway in feet, provided crest of dam is at least 5 feet above spillway level.

Fig. 2.

TABLE 5.

Evaporation Losses: Free Water Surface.

Month.	Cleveland Dam. Monthly evaporation losses. Inches.		Bulawayo Dam. Monthly evaporation losses. Inches.	
November	8.95		9.91	
December	8.03		9.07	
January...	7.47		9.74	
February	6.37		7.60	
March	7.40	38.22 (wet season)	8.25	44.57 (wet season)
April...	7.00		8.12	
May...	6.30		6.75	
June...	5.35		6.16	
July...	5.40		6.29	
August	6.82		8.12	
September	8.74	50.49 (dry season)	9.51	56.32 (dry season)
October	10.88	—year 88.71	11.37	—year 100.89

From this table it will be seen that the average evaporation loss varies in different localities from about 7 to 8 feet per annum and during the dry season from April to October the loss in depth from this cause may amount to between 4 and 5 feet. As the loss by absorption in the soil has also to be allowed for, it can be accepted that at least 8 feet depth of storage must be provided if water is to be available in the dam throughout the normal dry season unless the unavoidable losses are offset by a perennial stream following into the dam. A good storage site from the point of view of impounding capacity is one in which the stream channel has a flat gradient and further the site is improved if the valley opens out into a wide basin with relatively flat side slopes. In other words, the ideal dam site is a basin formation with a narrow outlet in which the embankment itself can be located.

The following method can be utilised for determining the storage capacity at a proposed dam site which, while admit-

tedly, is only very approximate, will yet be sufficiently accurate to determine the relative value of various alternative sites.

The full supply level of the dam can be roughly pegged out by placing a straight edge on the proposed spillway and then levelled up by means of an ordinary builder's level. By sighting across the top of the levelled straight edge the line of sight will intersect the ground; this point will be very approximately the full supply level and should be pegged. Several points on both sides of the valley can thus be staked out. If the sighting distance is limited shift the straight edge forward to the furtherest fixed full supply level, level up and repeat as before.

The area included within these stakes can then be estimated, or if, as is usual in the case of small dams, it is roughly triangular in shape, its area will be the width near the embankment multiplied by half the distance from the embankment to the furtherest stake in the stream bed upstream of the dam. If these distances are measured in feet the area can be converted into acres by dividing the product by 43560.

The average depth over this area may be roughly assumed as being one-fourth of the maximum depth at the embankment, and the capacity of the dam in acre-feet will be approximately the area below the full supply level in acres multiplied by one-fourth of the maximum depth of water at the embankment.

Thus if a dam has a full supply depth of 12 feet and the maximum width at full supply level is 300 feet and the water stands back when the dam is full for a distance of 2,000 feet from the embankment, its capacity in acre-feet will be very approximately.

$$\frac{300 \times 12/4 \times 2{,}000/2}{43560} \text{ acre-feet,}$$

i.e., just over 20 acre-feet, or 5 million gallons (4 acre-feet = approx. 1 million gallons).

As stated previously, this method is only very approximate, but it is of value in enabling a selection to be made of the most promising sites before these sites are inspected and surveyed by an engineer.

Subsidies and Loans.—In order to encourage the construction of water conservation works the Government has approved of a subsidy being paid to farmers who construct these works before the 31st December, 1940.

Such subsidy is limited to 25 per cent. of the estimated cost of the works and a maximum payment of £62 10s. 0d. per individual farm. In addition the subsidy is only payable in respect of works which have been approved by an Engineer of this Department and which must conform with the principles of construction as set out in this bulletin.

Irrigation loans are also available to cover the cost of construction of these works, the forms of application and the regulations governing them are obtainable from the Department of Agriculture.

Report of the Agriculturist

FOR THE YEAR ENDING 31st DECEMBER, 1936.

By D. E. McLoughlin, Agriculturist.

(*Continued.*)

A new Oat Variety: A.E.S. Kherson Hybrid.—About the year 1929 it was found that the hull-less strain of oats which had been distributed from the Agricultural Experiment Station a few years before was becoming more susceptible to rust attack each year, and an attempt was made to improve its powers of resistance by back-crossing it with a Kherson variety which, at that time, was highly resistant to most forms of "rust."

Although this effort did not succeed in producing a hull-less strain markedly superior to its parent, a number of promising hulled strains appeared, and from these one which has maintained its lead has been isolated. The general characteristics of this strain are similar to its Kherson parent, but in size, plumpness of grain and total yield it surpasses either parent and in addition is somewhat more resistant to attacks of rust than any other Kherson strain yet introduced. During the past three seasons small quantities of seed have been distributed to a number of farmers, and very favourable reports have resulted from their experience of it.

This oat is sufficiently rust resistant to produce good crops of hay under summer rainfall conditions, and when it is grown on fertile soil in the winter months, it produces large crops of grain suitable for use as a concentrate for horses.

Agricultural Experiment Station, Salisbury.—After an unfavourable opening when droughty conditions prevailed, the 1935-36 season became more favourable after the commencement of the New Year, and the season as a whole proved favourable for nearly all of the various kinds of crops grown on this Station.

A detailed report of the majority of the experiments in progress was published in the September issue of the *Rhodesia Agricultural Journal*, by the Manager, Mr. H. C. Arnold. The continuance of this work formed the major portion of the work of the Station during the season under review, but a number of new experiments were commenced. These deal mainly with problems conected with the practice of green manuring, and have for their object the discovery of the most economical manner of utilising the top-growth of the green manure crop. While the majority of the farmers of this Colony agree that very beneficial effects follow the ploughing in of green manure, a number are convinced that effects, which are equally beneficial or even more so, may be obtained when the crop is allowed to mature and the top growth is subsequently disposed of by burning it on the land. Experiments previously conducted at this Station tend to show that although some slight benefit may accrue from the ploughing under of the whole of the immature top-growth, the increased yields obtained are not commensurate with the large amount of additional material which is thus incorporated with the soil. In the new investigations the methods of treating the top-growth are as follows:—

(*a*) ploughing under the whole of the immature top-growth in the usual way;

(*b*) burning the mature top-growth just before ploughing the land;

(*c*) removal of the immature top-growth for the purpose of composting it and returning it to the land in the form of compost;

(*d*) ploughing under the roots only of the immature sunn-hemp plants after the complete removal of the top-growth;

(*e*) immature top-growth applied to land cropped to maize continuously.

In another series of experiments different rates of seeding sunnhemp are being tried with a view to finding whether the

succeeding crop will be influenced, and to find the most suitable rate of seeding when the top-growth is to be cut for hay or for silage.

A further series of trials provides for sowing the sunnhemp at fortnightly intervals and ploughing under the whole crop three months after the germination of the seed. The object of this experiment is to find out whether it is advantageous to delay ploughing under the sunnhemp in order that the valuable nitrogenous compounds which it brings to the soil, shall not be leached out by late rains.

The number of experiment plots in the trials for the 1936-37 season amount to 2,784. The Manager, Mr. H. C. Arnold, in his report, comments on the following points of interest:—

"Trials conducted at this Station over a period of several years have resulted in the discovery of superior strains of soya and velvet beans, and these are now generally grown by our farmers. Although these varieties produce luxuriant crops of fodder they have a few characteristics which lessen their value, and the elimination of the worst of these is now receiving attention. The seed pods of the soya beans have a tendency to open and scatter their seed before harvesting operations can be performed, and in certain seasons this results in considerable loss to the grower. By inter-breeding our heavy cropping varieties with non-shattering strains, promising new hybrids have been obtained, and it is believed that the chief drawback to the cultivation of the soya bean crop will thus be overcome within a few years.

" 'Somerset' velvet beans have proved suitable for all parts of the Colony, and even in the dryest years they are a never failing source of fodder rich in protein, but their thick fleshy pods render the conversion of the fodder into hay a difficult and tedious operation. An attempt to overcome this difficulty is being made by hybridising the Somerset variety with a late maturing (though shy-seeding) species, with the object of obtaining a strain which will retain the valuable qualities of both parents and, owing to delayed maturity, will be free of large pods at the close of the wet season, at which time hay making operations can be safely proceeded with.

Many promising hybrids have been obtained, but further testing is necessary before it will be possible to decide as to which of them are the most suitable for our purpose.

"A few years ago the discovery of two new methods of making silage was announced by certain Continental investigators. It was claimed that by the employment of either of these methods green fodder could be preserved in the form of silage with a minimum loss of protein, and that fodder preserved by either method would have a considerably higher feeding value than the same material cured as hay or as silage made by natural fermentation methods.

"One of these methods involves the use of acids, and it is thought that the cost of the acid, combined with the danger attending its use, make it of doubtful value to the farmers of this Colony. By the other method, molasses is mixed with the fodder when it is ensiled and, provided other conditions are favourable, this induced lactic acid fermentation instead of other fermentations which take place at higher temperatures and cause the loss of valuable nutrients in the fodder. Molasses being a by-product of the sugar industries which flourish in adjacent territories, it was though that experiments to test this method should be carried out.

"In March, 1932, small scale trials with molasses treated maize were made, but chemical analysis failed to show a higher percentage of protein in the treated silage than in the untreated material. (It was later found that the treatment is only employed on legumes.)

"In February, 1933, cowpea fodder was ensilaged with molasses, but in this case also the chemical analysis showed that the treated material was not richer in protein than the silage made from similar fodder but without the addition of molasses.

"In January of the same year veld grass treated with molases was ensiled, but owing to the nature of the material it could not be packed closely enough in the silo to exclude the greater part of the air, hence high temperatures were reached, which destroyed the lactic acid ferment.

"In the year 1934 further trials were made after brick-lined circular silos had been specially constructed and machinery to chaff the fodder into half-inch lengths had been obtained.

"The fodders ensiled were (1) sweet potatoes, (2) velvet beans, (3) dolichos beans. Two silos were filled simultaneously, one with molasses-treated fodder and the other with untreated fodder, to ensure that the air temperature, material, and treatment given should be exactly the same for both pits, the only difference being that 2 per cent. of molasses dissolved in 10 per cent. of water was added in the one case. Each of the various kinds of fodder was ensiled separately and samples of the fresh material of each were taken for analysis. Thermometers were embedded in the material to record the maximum temperature and finally the pits were sealed with damp earth, four feet in depth. When the pits were opened in August, 1934, the thermometers showed that the temperatures had not exceeded the low-temperature-silage level of 86° F. and that the maximum temperature of the untreated silage was virtually the same as that of the molasses silage. Samples of the silage were submitted to the Chemical Branch for analysis, and the results of the analyses showed that a slight reduction in the protein content of all the fodders had taken place, and that the molasses treated fodder had lost as much protein as that which had not been treated. It was found, however, that the palatability of the fodder had increased somewhat by the molasses treatment, and it is thought that this alone might justify its use in farm practice under certain conditions.

"In the season 1933-34 a saccharine sorghum named 'Wintersome' was introduced for trial. It proved to be a heavy cropper and it was suggested that its sugary juice might be used instead of molasses to improve the palatability of legume silage. Trials were made in the year 1935 when equal quantities of 'Wintersome' and velvet beans were mixed and ensiled together. Analyses were made of the fresh material as well as the silage and it was found that the loss of protein from the velvet bean fodder was less than that recorded in the molasses treated fodder, and the palatability of the legume had been considerably increased.

"Subsequent trials showed that a mixture containing two-thirds of velvet bean and one-third Wintersome gave silage which was palatable and relatively high in protein. Both Somerset velvet beans and Wintersome are hardy crops which are capable of yielding heavily on nearly every farm in this Colony, and it would apepar that when they are employed in the manner described they will be found to be a very economical source of succulent food of great value to livestock owners."

Unemployed Probationary Settlement, Chilimanzi.—The agricultural operations on this Settlement are supervised by the writer. Very satisfactory development and progress was made during the period under review, the second year of operations. The settlers all showed a very keen interest in their farming operations, and the fullest co-operation was extended to officials connected with the Settlement. During the year the school building and teacher's quarters were extended, the work being done by the settlers themeslves. The extensions were found necessary to provide facilities for an additional eight families placed on the Settlement during the year, thereby making a total of nineteen families. The lands were worked in a satisfactory manner, in separate units, and a good tilth was provided for seeding. The lime applied in the previous year appeared to have exercised a beneficial effect on both the physical condition of the soil and the growth of the crop, which was all that could be desired, attaining a height of 4 feet 6 inches. Growing conditions on the whole were favourable, although a shortage of moisture in the soil was experienced towards the end of the season on this type of moisture retaining vlei soil. The total acreage seeded to wheat by the eleven settlers was 326 acres. The seed was again drilled at the rate of 40 lbs. per acre, together with a dressing of 100 lbs. complete fertiliser per acre, analysing 40% P_2O_5, 8 N. and 12 K_2O. The date of planting extended from the beginning of May to the first week in June to provide data on the most suitable date of planting to escape damage by frost. Two severe frosts were experienced, one in August and one in the second week of September. All crops suffered severe damage from frost, and yields were reduced by 50 to 75 per cent. The best yields were obtained from the first three plots

planted from 1st to 10th May. The late plantings suffered most injury from the late and abnormal frost in September. Yields on individual holdings ranged from .9 to 2.7 bags of 200 lbs. per acre each. The total crop was 558 bags from 326 acres, or an average of 1.7 bags per acre.

A small scale experiment was carried out to test the efficacy of grazing wheat, to ensure its flowering after the advent of frosts and thus escaping injury. The results were of a negative character. Calves were used to graze the wheat, but on this type of light sandy soil insufficient root anchorage is provided and thus the plants were pulled out of the ground. Cutting by hand was substituted for grazing. The treatment had a depressing effect on yield. The cut portion yielded 484 lbs. and the uncut portion 842 lbs. of grain per acre.

During the latter end of the year a start was made with the installation of storm drains and contour ridging of all the land on the Settlement. This work will also serve as a demonstration to wheat farmers operating on vlei lands.

Plant Breeding Station, Hillside.—The following information is given in the report of the Plant Breeder, Mr. T. K. Sansom:—

Generally speaking, the season under review has been a satisfactory one. A total of 29.75 inches of rain fell and the distribution was ideal for the growing of crops.

Maize Breeding.—During the season the maize breeding work was resumed. The original material consisted of field selected strains of Salisbury White made at the Government sandveld farm, Marandellas, in 1930-31, and various strains of Johnson's County White obtained from the United States of America and reputed to be highly resistant to the incidence of diplodia attack. This season the crosses were grown on a commercial scale and the resultant crop was very satisfactory. No definite type has yet been fixed and the row numbers vary from 8 to 16 and both dent and flint types occur in each row type. It is the intention to fix a twelve row with a more flinty grain than that of Salisbury White.

Two pleasing characteristics of this new cross were (1) the tips and butts were well filled, (2) the small percentage of diplodia infected cobs. Seed of this new cross has been distributed to farmers for trial and is also being tested in a variety trial on the Salisbury Experiment Station. Single plant selections and selfed selections have been retained as usual and sown during the present 1936-37 season.

Winter Crops.—Generally speaking, rust has been extremely severe on the wheat crops in the Colony, and it is the writer's opinion that the increasing severity of rust is due to some extent to summer grown wheat and early planted winter wheat, *i.e.*, crops seeded in February and March. The quality of the crop was lower than that of the previous season. A very noticeable decline in the purity and quality of the wheat crops has been observed during the past year or two, and the writer cannot too strongly emphasise the necessity of pedigree seed being grown by farmers in seed plots. During the past season the protein contents as well as the bushel weights were lower than those of the previous season.

Plant Breeding Work.—The heavy rust infestation of the 1936 season again made it possible to eliminate a large number of wheats, and during the past season over 200 varieties and strains were under trial. Several of the wheats obtained from Kenya Colony proved highly resistant to rust, and it is hoped to distribute seed of these to farmers in the near future. The two Reward strains have maintained the promise they have shown in the past, and during the past season ranked with the very few wheats which withstood rust and produced good crops. Further very favourable reports were received on the milling and baking quality of Reward wheat, and one from the Manager, Rhodesia Milling and Manufacturing Company, was published in the *Rhodesia Agricultural Journal.*

Small Scale Yield Trials.—These trials have been carried on for four years now, and it is proposed to publish the results after reaping the 1937 crop. It may be mentioned now that the following wheats have consistently yielded well and can be recommended:—Kenya Governor, Quality, Lal Kasar Wali, Reward, Droop 3, Cawnpore 13.

Lal Kasar Wali has proved to be definitely better than Karachi, though there appears to be no difference in their growth habits.

Date of Seeding Trials.—During the two years these have run there has not been sufficient climatic variation to allow definite recommendations to be made, but with ample moisture in the soil sowings during the first half of May may be expected to give best results. Earlier sowings have been severely rusted, but when the rainfall is below normal or ceases early, earlier sowing from mid-April would probably give better results.

Rate of Seeding Trials.—The results of the second year of these trials confirmed the results of the first year. Eight rates of seeding rising by 10 lbs. per acre from twenty pounds to ninety pounds per acre were employed. The highest rate (90 lbs. per acre) gave the highest yield, and there was generally a progressive increase in yield from 30 lbs. rate to the 90 lbs. rate. The yield from the 20 lbs. per acre rate was only about half that from the highest rate. It is probable that the best rate of seeding lies between 60 and 80 lbs. per acre. The protein content was not significantly affected by the rate of seeding.

The bushel weight rose with the rate of seeding, from 63 10-16ths for the 20 lbs. rate, up to 66 13-16ths lbs. for the 80 lbs. rate.

Wheat Fertiliser Trials.—These have run two years, and the results confirm the previous year's results, and also results obtained during one year at Marandellas. The most striking fact brought out so far is the great value of moderate dressings of lime (1,000 or 2,000 lbs. per acre) on poor granite vlei soils. Lime has consistently given marked increases in yields, whether applied by itself or in combination with fertilisers and/or kraal manure. A dressing of 1,000 lbs. of lime per acre gave a greater yield of wheat by two bags per acre than 200 lbs. of complete wheat fertiliser, and less than one bag under the yield given by a dressing of 8 tons of kraal manure.

These results indicate that an application of ½ to 1 ton of agricultural lime could be given to vlei soils growing wheat with great advantage every two or three years.

Another very striking fact observed in these trials was that on all those plots which received lime either alone or in combination with manure or fertilisers, the wheat was far less severely infested with rust than the wheat on the plots which received no lime.

Barley.—The selection of improved types of malting barley is continuing.

Summer Green Manure Crops.—The value of various species of Sesbania, including the indigenous varieties, is being compared with that of sunnhemp as summer green manures.

The results this year are being masked by a heavy volunteer growth of the blue-flowered indigenous species *S. coerulescens.*

Clovers.—Kentish wild white clover has persisted in a remarkable way, without fertilisers or manure. In 1937 trials of this clover with and without grasses and fertilisers are being laid down.

Maize Grading and Export: General.—The grading and export season opened about one month later than usual. No grading was done during July, and grading did not commence in earnest until the second week in August.

A considerable quantity (131,000 bags) of maize was exported through Beira from Northern Rhodesia, and this and the exceptional shortness of the export season threw a greater burden than normal on the grading staff, but the work was carried out with energy and despatch, and no complaints were received.

Staff.—Mr. L. C. Roberts again acted as Senior Grain Inspector, and Mr. S. W. Cherry as a Temporary Grain Inspector. Messrs. C. Keppie and J. J. Meyer were employed for the first time as Temporary Grain Inspectors.

Remarks.—After a very severe drought in December and January ample rains fell in the latter half of the growing season, and finally a large crop of maize of excellent quality was reaped.

Owing to the rains continuing later than usual many tests for moisture content were necessary in August and September, and a total of nearly 300 moisture tests were carried out by the grading staff, which represented nearly 300 hours

employed on this work—a very considerable proportion of the time of the staff. Much of the maize from the immediate north and east of Salisbury was severely affected with diplodia, and there appears to be some increase in this disease in this area from year to year.

In October approximately 1,200 bags of No. 3 grade maize were rejected at Beira as "slightly weevily." This maize had been graded a month before railing. At some of the stations and sidings on the eastern line the stacking, spacing and sewing of the maize left much to be desired, notably at Macheke, Inyazura and Headlands, and at the latter place the Senior Grain Inspector was forced to refuse to grade the maize until it had been re-stacked.

It is of interest to note that 1.25 inches of rain fell on some 12,000 bags of maize stacked at Norton, but when this was graded three days later no damage was noted and the maize was dry.

The following are the statistics of the maize graded during the year. The native-grown maize is shown separately from that grown by European farmers.

European Maize.

	Grade 2.	Grade 3.	Grade 8.	Rejects.	Total.
	704,795	10,083	92	2,776	717,746
Percentages of grades... ...	98.2%	1.4%	0.01%	0.40%	

Native (Traded) Maize.

	Grade 2.	Grade 3.	Grade 8.	Rejects.	Total.
	nil	45,627	5,773	2,288	53,688
Percentages of grades... ...		85%	10.8%	4.2%	

Maize Exported during the Year 1936.

Via Beira January to June=(1934-35 crop) ...	156,777 bags
July to December=(1935-36 crop) ...	770,866 bags
Total	927,643 bags
To Bechuanaland	291 bags
Grand total	927,934 bags

Sunflower Seed.—A total of 2,114 bags was graded, of which 1,614 were Grade No. 4 and the remainder Grade No. 1.

Wheat Experiment: Umvuma.—The variety trial, and the rate of seeding trial, were continued this year on the farm of Mr. E. G. Raubenheimer with his co-operation, but the results of this year's sowings did not arrive in time to be included in this report, and they will be published at a later date in the *Rhodesia Agricultural Journal.*

Witchweed.—The following extracts are quoted from the report of the Assistant Agriculturist, Mr. S. D. Timson:—

"This parasite continues to be the most serious concern of the maize farmers throughout the Colony, but each year more farmers are proving the efficiency of the methods of control recommended by this Department.

"However, a resolution passed by the Mazoe (Concession) Farmers' Association contained a denial of their efficiency, and the writer therefore sent a circular letter to some thirty farmers throughout the maize belt, who are known or reported to be using these methods with success. Their replies all display the conviction that the parasite can be, and is being, effectively controlled by the methods advised, and these replies are now being published month by month in the *Rhodesia Agricultural Journal.* Some of them are written by members of the above Association, and they form a very effective answer to the resolution."

Costs of Control.—In the above reports there is valuable evidence concerning the cost of controlling witchweed by hand cultivation, and a combination of this and trap-cropping. The evidence strongly supports the contention of the writer that light surface hoeing of the parasite and leaving it to lie on the fields, each time it commences to flower, is very much cheaper than deep cultivation and hand picking of those parasites in flower.

Trap Crops.—The co-operative trials of Rhodesian (Native) Sudan grass have shown it to be an excellent host of witchweed and a free seeder and resistant to disease, pests, and both drought and wet conditions. It promises to be our best trap crop, since in addition it appears to be easily killed by plough-

ing under, and it is a perennial. Seed of this grass has been issued free to a number of farmers for the purpose of laying down a propagation plot.

Grassing Severely Infested Fields.—Co-operative trials of Woolly Finger grass and Rhodes grass by farmers in the Mazoe Valley on very severely infested soil have shown that the use of these grasses can be strongly recommended for this purpose. The grasses throve normally and practically no witchweed was brought to the surface.

Recent work on the same subject by Saunders at Potchefstroom yielded similar evidence of their value for grassing infested fields. The use of these grasses should materially assist the farmer in combating the parasite and in breaking away from the one crop farming of the maize belt, which has been one of the chief reasons for the rapid spread of the parasite.

Methods of Control and the Labour Shortage.—Hand hoeing remains the most popular method of control, but the increasing shortage of labour is causing farmers to pay attention to means of economy in this direction. The writer has written a note on this subject which will appear in the January issue of the *Rhodesia Agricultural Journal.*

Munga as a Partial Trap Crop.—The writer has drawn the attention of farmers to the possible use of this crop for witchweed eradication in various articles in the Press and the *Rhodesia Agricultural Journal.*

An experiment carried out by Mr. G. P. Ingram, of Concession, at the suggestion of the writer, indicates that munga is an excellent change crop to precede maize.

The Green Manure Value of Trap Crops.—An experiment laid down at the Agricultural Experiment Station, Salisbury, indicates that on witchweed free soil one crop of amber cane and white kaffir corn ploughed under within two months from germination gives an excellent result as a green manure. The results of this experiment have been published in the November, 1936, issue of the *Rhodesia Agricultural Journal.*

Lectures.—Lectures on the subject were delivered by the writer to the Poti Valley Farmers' Association and to the Arcturus Farmers' Association.

Articles.—Four articles and notes on the subject have been published during the year in the *Rhodesia Agricultural Journal* and one in the *Rhodesia Herald.*

The reports received from farmers in reply to the circular letter sent out by the writer are now being published in the *Rhodesia Agricultural Journal.*

Tours of Witchweed Areas.—Several tours of the Mazoe Valley were made by the writer in connection with witchweed control investigations.

Tours of the Poti Valley Farmers' Association district, and of the Hartley-Gatooma area and of the Banket and Sinoia areas in the same connection, were also made.

Southern Rhodesia Weather Bureau.

NOVEMBER, 1937.

Barometric Pressure was about normal over the whole country.

Temperatures were uniformly above normal, averaging 3° in excess.

Air Masses during November.—The main air supply, particularly in the north of the country, was the Indian Ocean Trade current, which was exceptionally persistent this year. In the south of the country there were frequent incursions of Maritime air, its effects being felt on fifteen days, but its influence only extended to the north on about six days.

Cold southerly air only invaded the country once, on the 16th.

Equatorial air made its appearance over Northern Rhodesia towards the end of the month, but only affected the Victoria Falls area for a brief period on the 29th and 30th. The North-east Monsoon did not set in on the Tanganyika Coast during the month, and no moist air was received from this source.

Consequent on the persistence of the Trades and the absence of the moist currents, rainfall was very scarce. The little which did fall was of the thundershower type mainly, and occurred with upper south to south-west winds, or with frontal movements of maritime air. No general rains occurred. The wettest spells were the 15th to 17th and 24th and 25th.

PRECIPITATION.

Stations.	Inches.	Normal.	No. of days.
Beitbridge	0.37	2.06	3
Bindura	1.15	3.21	9
Bulawayo	1.86	3.23	3

Stations.	Inches.	Normal.	No. of days.
Chipinga	1.50	4.33	5
Enkeldoorn...	1.57	3.55	8
Fort Victoria	0.77	2.86	3
Gwaai Siding	0.71	2.79	5
Gwanda...	0.10	2.37	2
Gwelo	1.05	3.70	5
Hartley	0.73	3.76	10
Inyanga...	2.39	3.92	10
Marandellas	2.93	4.09	9
Miami	1.13	3.25	6
Mt. Darwin	2.94	3.34	6
Mt. Nuza	2.70	8.44	9
Mtoko	0.43	3.13	4
New Year's Gift	0.42	2.95	4
Nuanetsi	0.17	2.54	2
Plumtree	1.80	2.82	5
Que Que	0.95	3.01	7
Rusape...	1.66	4.58	7
Salisbury	2.83	3.65	13
Shabani	0.31	1.88	4
Sinoia	1.54	3.50	11
Sipolilo...	3.71	3.17	7
Stapleford	2.29	6.80	10
Umtali	0.83	3.84	6
Victoria Falls...	1.19	2.39	4
Wankie...	0.79	2.02	4

NOVEMBER, 19[illegible]

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	8-30 a.m. Wet Bulb.	8-30 a.m. Dew Point	8-30 a.m. Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days Max. > 85°	Max. < 70°	Min. > 65°	Min. ≯ 40°	Mean of 24 hours	Pressure Millibars 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Angus Ranch... ...	...	...	...	...	...	...	...	...	...		...		...	...	...	...	...	...	...	...	...	...
Beitbridge...	1,500	78.8	66.8	60	16.0	93.3	69.8	81.5	107	14th	64	5th	26	...	23	...	81.8	963.9	883.0	...	4.6	...
Bindura...	3,700	75.4	63.6	56	14.6	88.6	65.5	77.1	100	15th	61	4th	23	...	11	...	76.2	891.2	881.4	...	3.7	...
Bulawayo	4,393	73.6	60.8	51	15.0	87.3	62.4	74.9	97	14th	53	21st	22	...	5	...	74.3	869.2	880.5	867.3	4.2	9.3
Chipinga	3,685	71.6	63.6	59	9.4	80.8	59.8	70.3	93	14th	55	2nd	7	3	2	...	69.1	892.7	882.2	...	4.9	...
Enkeldoorn...	4,788	72.6	60.9	53	13.8	84.7	59.8	72.3	94	14th	54	21st	15	2	1	...	70.7	857.5	880.7	...	2.7	...
Fort Victoria	3,571	74.8	63.1	56	14.2	87.3	62.2	74.7	101	14th	55	12th	17	1	5	...	74.7	895.2	881.2	...	4.4	...
Gwaai Siding	3,278	79.9	64.1	54	20.5	95.9	64.9	80.4	105	7th	56	22nd	27	...	15	...	...	903.2	880.3	...	3.0	...
Gwanda...	3,233	75.6	63.5	56	14.7	89.4	65.1	77.3	102	14th	58	21st	23	...	11	...	76.7	905.5	881.0	...	4.7	...
Gwelo	4,629	73.4	61.4	53	14.1	86.9	61.0	73.9	95	14th	55	21st	22	...	2	...	72.9	862.2	880.6	...	3.5	...
Hartley...	3,879	77.1	62.8	53	17.4	89.8	62.6	76.2	99	15th	58	6th	25	1	6	...	75.9	885.1	880.6	...	3.8	...
Inyanga...	5,503	71.6	59.3	50	13.8	81.0	56.1	68.5	90	15th	51	14th	2	1	...	...	67.2	...	...	...	3.3	...
Marandellas	5,453	70.7	59.0	50	13.2	81.0	58.3	69.7	92	15th	53	21st	4	2	...	...	68.7	...	...	...	1.3	...
Miami	4,090	74.8	62.9	55	14.5	86.9	64.1	75.5	98	15th	60	21st	21	...	8	...	74.7	878.3	880.3	...	2.5	...
Mount Darwin ...	3,179	77.1	65.3	59	15.0	89.8	65.8	77.8	102	15th	60	9th	25	...	14	...	77.4	907.2	...	...	3.7	...
Mount Nuza	6,668	61.5	56.2	52	5.4	69.2	53.6	61.4	82	15th	48	21st	...	14	...	...	60.1	802.2	881.0	801.2	6.3	...
Mtoko	4,141	73.5	62.6	55	13.0	84.8	62.5	73.7	95	15th	57	5th	11	...	4	...	73.1	877.5	881.0	...	2.3	..
New Year's Gift...	2,690	75.0	66.5	62	10.8	89.0	62.3	75.7	101	14th	58	5th	22	...	3	...	...	...	...	...	...	8.6
Nuanetsi	1,581	77.5	67.6	63	13.0	93.8	66.7	80.3	109	14th	59	4th	24	...	18	...	...	961.9	883.3	...	...	...
Plumtree	4,549	76.0	60.5	49	18.4	87.7	64.6	76.1	96	23rd	55	21st	21	...	11	...	75.2	863.9	879.8	...	2.6	...
Que Que...	3,999	75.6	62.6	54	15.8	89.7	63.8	76.7	97	14th	58	21st	23	...	9	...	76.4	881.3	880.5	...	2.8	...
Rusape	4,648	71.8	60.8	53	12.7	84.1	58.4	71.3	96	15th	54	21st	13	1	...	...	70.5	..	. .	...	2.3	...
Salisbury	4,831	72.8	60.9	53	15.0	85.4	60.5	72.9	95	15th	56	4th	17	1	2	...	71.8	856.2	880.5	854.4	3.6	9.1
Shabani...	3,131	76.1	63.6	56	15.2	89.5	65.2	77.3	103	14th	56	21st	22	...	11	...	76.9	...	...	...	4.2	...
Sinoia	3,795	77.0	64.6	57	15.7	89.5	62.8	76.1	100	15th	58	12th	23	...	8	...	75.9	887.8	880.7	...	3.5	...
Sipolilo	3,876	76.7	64.1	56	15.3	86.4	64.9	75.7	96	15th	61	17th	19	1	10	...	...	884.9	880.6	...	3.0	...
Stapleford	5,304	66.5	60.1	56	7.0	76.0	52.7	64.4	88	15th	43	12th	1	4	...	...	63.5	842.5	881.2	...	4.7	...
Umtali	3,672	73.9	64.2	58	12.0	88.0	61.3	74.7	102	15th	57	2nd	20	...	1	...	72.9	892.9	882.0	891.2	5.0	9.1
Victoria Falls... ...	3,009	83.4	66.7	56	24.0	99.1	68.8	83.9	106	14th	63	8th	30	...	28	...	...	910.4	879.8	...	2.6	...
Wankie	2,567	86.7	67.8	56	27.0	100.9	76.3	88.6	108	8th	68	27th	30	...	30	...	87.8	924.9	880.0	...	2.8	...

Rainfall in November, 1937, in Hundredths of an Inch. Telegraphic Reports.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total	Normal
...	...	...	25	4	1	...	...	...	...	...	...	...	...	...	...	16	...	...	...	...	...	16	...	5	...	...	...	...	22	89	276
...	...	...	...	15	2	...	...	...	...	...	...	...	...	2	...	29	8	1	...	...	...	...	21	...	5	...	...	...	...	83	266
...	1	...	...	38	...	17	5	...	...	...	...	...	...	10	...	...	63	5	...	...	...	...	...	...	22	...	...	...	...	161	449
...	...	...	1	9	2	5	...	...	...	...	...	...	...	1	1	74	13	1	...	...	...	...	8	23	...	...	...	...	5	143	341
...	...	...	...	8	...	...	...	...	...	...	...	...	...	...	11	...	...	10	...	...	...	...	...	11	37	...	...	5	44	126	245
1	...	...	1	20	3	5	...	...	...	...	...	...	...	43	47	3	9	9	...	...	...	...	2	10	...	...	...	...	...	153	355
2	...	...	...	27	16	20	17	...	...	...	...	...	...	25	11	6	28	12	...	...	...	...	4	12	4	...	...	...	...	184	429
...	...	...	1	35	1	56	3	...	...	...	...	...	...	28	8	25	49	4	1	...	...	...	19	42	25	...	1	1	...	299	363
...	...	...	7	38	...	15	3	...	...	...	...	...	...	5	7	1	10	4	5	...	...	...	25	1	41	...	...	...	...	162	311
...	...	...	...	...	3	6	45	...	...	...	...	...	...	...	...	41	6	5	...	...	...	...	...	13	50	...	...	...	...	169	329
...	...	...	3	19	3	12	7	...	...	...	...	...	...	11	9	20	19	5	1	...	...	2	8	12	18	...	...	1	7	157	311

Southern Rhodesia Veterinary Report.

OCTOBER, 1937.

DISEASES.

Foot and Mouth.—There was a slight extension of the disease to the Sabi-Tanganda Estates in the Melsetter district.

African Coast Fever.—The disease was diagnosed on the farm Verzamel Plaats, in the Melsetter district. A stray beast found on the farm Confidence, Melsetter district, was destroyed, and on smear examination revealed African Coast fever.

TUBERCULIN TEST.

Twenty-one bulls and 66 cows were tested upon importation with negative results.

Thirty-five cows and 1 bull on the farm Glen Gray, Salisbury district, were tested, of which one beast reacted to the test and was destroyed.

MALLEIN TEST.

Twenty-nine horses and 25 mules were tested upon entry. No reactions.

IMPORTATIONS.

From the Union of South Africa.—Horses 29, mules 25, bulls 21, cows 67, sheep 1,684.

EXPORTATIONS.

To the Union of South Africa.—Oxen 524, cows 3.

To Northern Rhodesia.—Oxen 324.

To Portuguese East Africa.—Oxen 50.

EXPORTATIONS—MISCELLANEOUS.

To the United Kingdom in Cold Storage.—Chilled beef quarters, 4,822; frozen beef quarters, 2,549; frozen boned quarters, 3,441; kidneys, 1,270 lbs.; tongues, 5,530 lbs.; livers, 8,099 lbs.; hearts, 1,332 lbs.; tails, 1,443 lbs.; skirts, 984 lbs.; shanks, 7,185 lbs.

To Northern Rhodesia.—Beef, 88,128 lbs.; pork carcases, 68¾; veal carcases, 9.

Meat Products.—From Liebig's Factory: Corned beef, 90,156 lbs.; meat extract, 36,010 lbs.; beef powder, 49,701 lbs.; tongues, 30 lbs.; rolled beef, 396 lbs.

G. C. Hooper Sharpe,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-37.

Monthly Report No. 60, November, 1937.

Winged swarms of the Red Locust (*Nomadacris septemfasciata*, Serv.) have been present in the Colony throughout the month, reports having been received from the following districts:—Melsetter, Umtali, Marandellas, Makoni, Mrewa, Inyanga, Salisbury, Mazoe, Darwin, Hartley, Gwelo, Selukwe, Chilimanzi, Sebungwe, Victoria, Gutu, Bulawayo, Umzingwane, Matobo and Insiza.

The size of the swarms has varied from "small" to "very large." No definite trend of direction is indicated by the reports.

Specimens received at headquarters indicate that the swarms have not yet attained the egg-laying stage.

In certain localities large numbers of storks (two species) and kites are stated to have been following the swarms closely.

Specimens of locusts picked up dead have been examined but no trace of disease or parasites has been found.

Damage to early grass and fruit trees has been reported in two localities.

The general position has been very similar to that obtaining during November last year.

RUPERT W. JACK,
Chief Entomologist.

Departmental Bulletins.

The following Bulletins are available for distribution at 3d. per copy. Application should be made to the Editor, Department of Agriculture, Salisbury, and remittances must accompany orders.

N.B.—The date the article appeared in the Journal is indicated in abbreviated form before the number, e.g., 8/22, No. 429, means that Bulletin 429 appeared in the Journal for August, 1922.

AGRICULTURE AND CROPS.

7/25. No. 545. Artificial or Synthetic Farmyard Manure, by H. G. Mundy, Dip.Agric., F.L.S.

3/27. No. 630. The Storage of Seed Potatoes, by H. C. Arnold.

5/27. No. 643. Noxious Weeds in Southern Rhodesia, by F. Eyles, Botanist.

12/27. No. 663. The Use of Fertilisers and Manures in Southern Rhodesia, by A. D. Husband, A.I.C., Chief Chemist.

2/28. No. 672. Hay-making in Rhodesia, by H. G. Mundy, Dip.Agric., F.L.S.

2/28. No. 674. Top Dressing of Maize against Stalk Borer, by H. C. Arnold.

3/28. No. 681. The Sunflower (Helianthus Annuus) (Revised), by S. D. Timson, M.C., Dip.Agric.

6/28. No. 695. The Castor Oil Plant (Ricinus spp.), by S. D. Timson, M.C., Dip.Agric.

9/28. No. 705. Suggested Cropping Programmes for Farms on the Sand Veld, by D. E. McLoughlin, Assistant Agriculturist.

10/28. No. 710. Monthly Reminders for the Farming Year, by the Division of the Chief Agriculturist.

3/29. No. 727. Farmyard Manure, by A. P. Taylor, M.A., B.Sc., Agricultural Chemist.

3/29. No. 732. Two Common Diseases of Potato Tubers in Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.

7/29. No. 743. Sunn Hemp, by S. D. Timson, M.C., Dip.Agric.

9/29. No. 751. The Sweet Potato, by S. D. Timson, M.C., Dip.Agric. (Wye).

10/29. No. 758. Instructions for Taking Soil Samples. Issued by the Division of Chemistry.

1/30. No. 768. The Ground Nut (Arachis hypogaea), by S. D. Timson, M.C., Dip.Agric. (Wye).

3/30. No. 776. Regulations Governing the Export of Maize and Maize Meal through the Port of Beira.

11/30. No. 797. Green Manuring: An Essential Practice in Rhodesian Farming, by H. G. Mundy, Dip.Agric. (Wye), F.L.S., Chief Agriculturist.

1/31. No. 802. Witch Weed, by S. D. Timson, M.C., Inter.B.Sc. (Agric.) London., Dip.Agric (Wye), Assistant Agriculturist.

3/31. No. 815. New Strains of Oats for Southern Rhodesia, by H. C. Arnold, Manager, Agricultural Experiment Station, Salisbury.

4/31. No 816. Preliminary List of the more Common Grasses of Southern Rhodesia, by Sydney M. Stent, Botanist for Pasture Research.

5/31. No. 822. Re-stacking of Maize rejected for Export on account of Excessive Moisture.

9/31. No. 826. Some Poisonous Plants of Southern Rhodesia, by Sydney M. Stent, Senior Botanist.

10/31. No. 831. Revised Notes on Cotton Growing in Southern Rhodesia, by G. S. Cameron.

11/31. No. 836. The Potato, by S. D. Timson, M.C., Dip.Agric. (Wye).

12/31. No. 837. Veld Grass Silage: A Feature in Rhodesian Pasture Management, by H. G. Mundy, Dip.Agric. (Wye), F.L.S., Chief, Division of Plant Industry.

6/32. No. 855. Pigeon-hole Method of Stacking Maize, by Division of Plant Industry.

8/32. No. 859. Twenty-one Years of Plant Introduction, by Major Mundy, Chief Division of Plant Industry.

2/33. No. 878. A.I.V. Silage: Memorandum prepared and circulated by Imperial Bureau of Animal Nutrition.

11/34. No. 936. Witchweed, by S. D. Timson, M.C. Dip.Agric. (Wye), Assistant Agriculturist.

10/35. No. 970. Rhodes Grass for the Southern Rhodesian Tobacco Grower, by African Explosives and Industries, Ltd.

11/35. No. 972. Notes on Witchweed, by S. D. Timson, M.C., Dip.Agric. (Wye), Assistant Agriculturist.

6/36. No. 992. Annual Report of the Agriculturist for the year 1935, by D. E. McLoughlin, Agriculturist.

7/36. No. 994. Some Notes on Cotton Growing, by J. E. Peat, Senior Plant Breeder, Cotton Station, Gatooma.

4/37. No. 1022. Smut Diseases of Wheat in Southern Rhodesia, by G. M. Wickens, B.Sc. Agric., Ph.D., D.I.C., Plant Pathologist, Tobacco Research Station, Trelawney.

10/37. No. 1046. Green Manuring: Two Important Factors Affecting Success, by S. D. Timson, M.C., Assistant Agriculturist, and H. C. Arnold, Manager, The Agricultural Experiment Station.

REPORTS ON CROP EXPERIMENTS.

7/27. No. 649. Annual Report of Experiments, 1925-26, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Manager.

4/28. No. 683. Annual Report of Experiments, 1926-27, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Station Manager.

7/29. No. 745. Salisbury Agricultural Experiment Station Annual Report, 1927-28, by H. C. Arnold.

7/30. No. 789. Agricultural Experiment Station, Salisbury. Annual Report of Experiments, 1928-29, by H. C. Arnold.

9/31. No. 830. Salisbury Agricultural Experiment Station, Annual Report, 1929-30, by H. C. Arnold, Manager.

10/32. No. 864. Annual Report, 1930-31: Agricultural Experiment Station, by H. C. Arnold, Station Manager.

6/33. No. 895. Salisbury Agricultural Experiment Station Annual Report, 1931-32, by H. C. Arnold, Manager.

3/34. No. 914. Gwelo Municipal Demonstration Station: Final Report, 1933, by S. D. Timson, M.C., Dip.Agric. (Wye), Assistant Agriculturist.

9/35. No 965. Salisbury Agricultural Experiment Station Annual Report, 1933-34, by H. C. Arnold, Manager.

TOBACCO.

8/26. No. 605. Flue-curing Tobacco Barns, Bulking and Grading Sheds, by P. H. Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.

9/26. No. 615. The Culture of Virginia Tobacco in Southern Rhodesia: Field Management, by D. D. Brown.

5/27. No. 641. The Handling, Grading and Baling of Cured Virginia Tobacco, by D. D. Brown.

5/27. No. 644. Tobacco Baling Boxes, by B. G. Gundry, Irrigation Branch.

9/27. No. 653. The Care of Tobacco Seed Beds, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad)

11/27. No 661. Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16 ft., by B. G. Gundry.

1/28. No. 665. Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.

2/28. No. 671. Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.

12/28. No. 715. Turkish Tobacco Culture in Southern Rhodesia, by D. D. Brown, Chief Tobacco Expert.

3/29. No. 728. Suggested Crop Rotations for Tobacco Growers, by D. D. Brown, Chief Tobacco Expert.

4/29. No. 734. Common Faults in Curing Virginia Bright Tobacco, by D. D. Brown, Tobacco and Cotton Expert.

8/29. No. 748. Frog Eye Disease of Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

9/29. No. 753. Leaf Spotting of Tobacco caused by Mosaic, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

2/30. No. 771. Dark Fire-cured Tobacco: Field Operations, by D. D. Brown, Chief Tobacco Expert.

3/30. No. 774. Dark Fire-cured Tobacco: Harvesting and Curing, by D. D. Brown, Chief Tobacco Expert.

6/30. No. 784. Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.

3/31. No. 812. Selection of Tobacco Seed Plants, by H. F. Ellis, M.Sc., B.S. (Agric.), Tobacco Adviser.

11/31. No. 835. Tobacco Culture: Transplanting Operations, by D. D. Brown.

3/32. No. 846. Leaf Curl in Tobacco, by Dr. H. H. Storey.

3/33. No. 885. Tobacco Culture in Southern Rhodesia: The Harvesting and Curing of Virginia Tobacco, by D. D. Brown, Chief Tobacco Officer.

8/36. No. 996. The "Gundry" Tobacco Furnace, by B. G. Gundry, A.I.Mech.E.

12/36. No. 1009. Tobacco Research on the Trelawney Station 1935-36 Season.

4/37. No. 1025. Report of the Tobacco Research Board, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture and Chairman of the Tobacco Research Board.

5/37. No. 1026. Notes on Tobacco Root-Knot Nematode, by J. C. Collins, B.Sc., Biologist, Trelawney Tobacco Research Station.

8/37. No. 1039. Some Tobacco Pests that can be serious, by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.

LIVE STOCK.

1/27. No. 624. The Construction of Dipping Tanks for Cattle (Revised).

1/31. No. 801. Sheep Farming in the Melsetter District, by J. C. Kruger, Part-time Sheep Adviser in the Melsetter District.

10/32. No. 863. Piggeries, by B. G. Gundry, A.I.Mech.E.

12/32. No. 871. Some General Observations on the Feeding of Dairy Cows on a Mixed Stock Farm, by Dr. A. E. Romyn, Senior Animal Husbandry Officer.

1/33. No. 873. The Hand-rearing of Calves, by C. A. Murray, B.Sc. (Agric.), M.Sc.

4/33. No. 887. The Type of Chiller Steer required for Export, by A. E. Romyn, Senior Animal Husbandry Officer.

5/33. No 891. Fattening Bullocks for Export, by A. E. Romyn, Senior Animal Husbandry Officer.

9/33. No. 903. The Handling, Preparation and Chilling of Cattle for Export, by C. A. Murray, Lecturer in Animal Husbandry.

12/33. No. 907. The Blackhead Persian: Its Breeding and Management in Matabeleland, by C. A. Murray, M.Sc., Lecturer in in Animal Husbandry, Matopo Estate.

1/34. No. 909. Stall Fed Chillers for the Overseas Christmas Market, by C. A. Murray, M.Sc., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.

2/34. No. 912. Economical Winter Rations for Wintering Dairy Heifers, by C. A. Murray, M.Sc. (Agric), Lecturer in Animal Husbandry, Matopo School of Agriculture.

4/34. No. 916. Cowpea Hay in the Ration for Bacon Pigs, by C. A. Murray, M.Sc. (Agric.), Lecturer in Animal Husbandry, Matopo School of Agriculture and Experiment Station.

5/34. No. 919. Saltbush: A Winter Succulent for Sheep in Matabeleland, by D. G. Haylett, M.Sc., Ph.D., Director, Matopo School of Agriculture.

6/34. No. 924. Raising Dairy Calves on a Limited Amount of Whole Milk, by C. A. Murray, M.Sc., Agr., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.

1/35. No. 943. Cattle Improvement and a Cattle Breeding Policy in Southern Rhodesia: A Review of the General Position Chiefly as regards Ranching Cattle, by Dr. A. E. Romyn, Chief Animal Husbandry Officer.

1/35. No. 945. A Home-made Cow Stanchion, by Major R. R. Sharp, Whinburn, Redbank.

3/35. No. 946. Economical Rations for Wintering Dairy Cattle, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station.

5/35. No 952. Annual Report of the Chief Animal Husbandry Officer for the year ending 31st December, 1934, by A. E. Romyn, Chief Animal Husbandry Officer.

7/35. No. 959. The Selection of a Dairy Bull, by A. E. Romyn, Ph.D., Chief Animal Husbandry Officer.

4/36. No. 984. Report on the Curing of Rhodesian Hides, by Advisory Committee on Hides and Skins of the Imperial Institute.

4/36. No 985. Export of Frozen Porkers. Third Consignment to Smithfield. Division of Animal Husbandry.

5/36. No. 987. The Curing of Hides and Skins on the Farm, by The Division of Animal Husbandry.

5/36. No. 988. Preparing Cattle for Show, by The Animal Husbandry Division.

6/36. No. 989. The Supplementary Feeding of Mineral and Protein Supplements to Growing Cattle in Southern Rhodesia and its Relation to the Production of Beef Steers, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E. Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Southern Rhodesia; D. G. Haylett, Ph.D., Director, Rhodes Matopo Estate; F. Ericksen, Dip. Agric., Experimentalist.

10/36. No. 1001. The Raising of Bacon Pigs, by A. E. Romyn, Chief Animal Husbandry Officer, and C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate, with a Veterinary Section by D. A. Lawrence, Director of Veterinary Research.

9/36. No. 1000. Sheep Management on the Mixed Farm, by R. H. Fitt, Animal Husbandry Officer.

4/37. No. 1023. Cowpea Molasses Silage for Fattening Steers, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station; A. E. Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Salisbury; R. H. Fitt, Dipl. Agric., Animal Husbandry Officer, Department of Agriculture, Salisbury.

4/37. N. 1024. Comparative Feeding Value of Maize Meal and Nyouti (*Pennisetum Typhoides*) Meal for Fattening Steers, by C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E. Romyn, Chief Animal Husbandry Officer.

5/37. No. 1027. The Feeding of Phosphorus Supplements to Growing Cattle, by C. A. Murray and A. E. Romyn.

5 37. No. 1029. The Dehorning of Cattle intended for Slaughter and Export, by B. A. Myhill, Assistant Chief Veterinary Surgeon.

5/37. No. 1030. The Feeding of Different Winter Supplements to young growing steers and the effect of these supplements on the subsequent development and costs of production of the steers, by C. A. Murray and A. E. Romyn.

6/37. No. 1032. The Effects of Feed on the Firmness and Grading of Bacon Carcases, an experiment carried out by the Division of Animal Husbandry in co-operation with Mr. A. L. Millar, Estes Park, Salisbury, and Mr. Frank Neill, of Neill's Bacon Factory, Salisbury.

6/37. No. 1034. Nyouti or Munga (*Pennisetum typhoides*) as a Feed for Bacon Pigs, by C. A. Murray and A. E. Romyn.

7/37. No. 1036. Preliminary Report on the Feeding of Winter Supplements to young growing steers and the effect of supplementary feeding on the subsequent development of these animals, by C. A. Murray and A. E. Romyn.

12/37. No. 1049. The Export of Frozen Porkers: Report on Five Consignments of Porkers Exported to Smithfield, by Division of Animal Husbandry.

DAIRYING.

3/29. No. 730. Common Defects in Butter-making, by T. Hamilton, M.A., N.D.A., N.D.D., and J. R. Corry, B.Sc. (Agr.), Dairy Experts.

12/30. No. 799. The Objects of Ripening Cream for Butter-making, and a few Hints on Cream Production, by F. Lammas, Dairy Officer.

4/31. No. 818. Farm Butter-making. Issued by the Dairy Branch.

9/32. No. 862. Cream Cheese, by F. A. Lammas, Dairy Officer.

3/33. No. 880. Dairy Tests and Calculations, by F. A. Lammas, Dairy Officer.

5/34. No. 922. Dairy Building in Southern Rhodesia: A Small Farm Dairy, by G. B. Gundry, A.I.Mech.E.

7/34. No. 926. Dairy Buildings in Southern Rhodesia. Cow Byre—Type II., by B. G. Gundry, A.I.Mech.E.

12/34. No 937. Gouda or Sweet Milk Cheese, by F. Lammas, District Dairy Officer.

2/36. No. 977. Notes on the Feeding of Dairy Cows during the Summer Months, by A. E. Romyn, Chief Animal Husbandry Officer.

6/36. No. 990. Southern Rhodesia Milk Recording Scheme.

12/37. No. 1051. The Production and Handling of Milk and Cream, by the Dairy Branch.

VETERINARY.

10/14. No. 191. Scab or Scabies in Sheep and Goats, by Rowland Williams, M.R.C.V.S.

4/25. No. 536. Inoculation of Cattle against Redwater and Gall Sickness, by Ll. E. W. Bevan, M.R.C.V.S.

12/25. No. 570. The Spaying of Bovines, by G. C. Hooper Sharpe, M.C., M.R.C.V.S., and M. H. Kingcombe, M.R.C.V.S.

6/26. No. 597. Suspected Poisoning of Stock: The Proper Procedure, by M. H. Kingcombe, M.R.C.V.S. (Lond.), and A. W. Facer, B.A. (Oxon.), A.I.C.

12/26. No. 618. Notes from the Veterinary Laboratory: Quarter Evil, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.

1/28. No. 666. Notes from the Veterinary Laboratory: Praemonitus—Praemunitus, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.

4/29. No. 739. The Laboratory Diagnosis of Animal Diseases: A Note to Emphasise some Points in the Preparation and Forwarding of Specimens, by D. A. Lawrence, B.V.Sc., Veterinary Research Officer.

10/29. No. 756. Parasitic Gastritis of Cattle, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.

11/29. No. 760. A Note on Sheep Diseases in Southern Rhodesia, by D. A. Lawrence, B.V.Sc., Veterinary Research Officer, Department of Agriculture, Salisbury.

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5/34. No. 921. Myiasis (Screw-Worm) in Cattle in Southern Rhodesia, by D. A. Lawrence, Director of Veterinary Research, and A. Cuthbertson, Entomologist.

IRRIGATION, WATER SUPPLIES AND SOIL EROSION.

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FORESTRY.

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4/30. No. 778. The Utilisation of Wood in Southern Rhodesia—Conversion and Disposal of Timber, by T. L. Wilkinson, M.Sc., B.Sc.F., District Forest Officer.

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2/31.	No. 809.	Establishing Pines: Preliminary Observations on the Effects of Soil Inoculation. Issued by the Division of Forestry.
4/31.	No. 817.	The Raising of Forest Seedlings and Transplants on the Farm, by E. J. Kelly Edwards, M.A., Dip.For. (Oxon.), Acting Chief Forest Officer.
7/32.	No. 857.	Charcoal Burning on the Farm, by R. J. Allen, Forester, Rhodes Matopo School of Agriculture and Experiment Station.
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		Price List of Forest-tree Transplants, Ornamental Trees Shrubs, Hedge Plants, Creepers and Seeds obtainable at the Government Forest Nursery, Salisbury.
3/37.	No. 1020.	The Raising of Forest Seedlings and Transplants on the Farm, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.
10/37.	No. 1045.	Seventeenth Annual Report of the Division of Forestry for the Year 1936, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.

HORTICULTURE

4/27.	No. 637.	Harvesting, Packing and Marketing of Deciduous and Tropical Fruits, by G. W. Marshall, Horticulturist.
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ENTOMOLOGY AND PLANT PATHOLOGY.

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2/21.	No 385.	The Common Fruit Beetle, by R. W. Jack, F.E.S.
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8/25.	No. 548.	Insect Pests of Cotton, by C. B. Symes.
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1/28.	No. 665.	Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.
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7/30.	No. 790.	Notes on the Control of Some of the More Important Insect Pests of Citrus in Southern Rhodesia, by W. J. Hall, Ph.D., B.Sc., Entomologist to the British South Africa Company in Southern Rhodesia.
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7/33.	No. 897.	The Report of the Chief Entomologist for the year ending 31st December, 1932, by Rupert W. Jack, F.E.S., Chief Entomologist.
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6/35. No. 957. Annual Report of the Branch of Plant Pathology for the year ending 31st December, 1934, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

8/35. No. 962. The Report of the Chief Entomologist for Year ending 31st December, 1934, by R. W. Jack, Chief Entomologist.

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5/36. No. 986. Annual Report of the Division of Entomology for year ending 31st December, 1135, by Rupert W. Jack, Chief Entomologist.

7/36. No. 993. Annual Report of the Senior Plant Pathologist for year ending 31st December, 1935. Part I.: Plant Pathology. Part II.: Tobacco Research, by J. C. S. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist and Officer in Charge of Tobacco Research Station, Trelawney.

12/36. No. 1011. Tick Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist. Revised, November, 1936.

7/37. No. 1037. Division of Entomology: Annual Report for year 1936, by R. W. Jack, Chief Entomologist.

8/37. No. 1040. A Programme for the Control of Diseases of Apple Trees in Southern Rhodesia, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

10/37. No. 1047. Mycological Notes: Seasonal Notes on Tobacco Diseases. X.: Precautionary Methods in Seed-beds, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

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POULTRY.

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6/25. No. 542. Review of the Abnormal Rainfall Season, 1924-25, by C. L. Robertson, B.Sc., A.M.I.C.E.
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10/31. No. 832. The Weather Map and the Short Period Weather Forecast, issued by the Meteorological Office.
2/33. No. 877. Clouds and Weather in Southern Rhodesia, by N. P. Sellick, M.C., B.Sc., Meteorologist.
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AGRICULTURAL BUILDINGS.

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CHEMISTRY.

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4/32. No. 852. Mixing of Fertilisers: A Guide to Methods of Calculation, by the Division of Chemistry.

7/32. No. 858. The Softening of Waters, by the Division of Chemistry.

1/34. No. 910. The Toxicity to Grazing of Grass Sprayed with a Solution of Sodium Arsenite, by A. D. Husband, F.I.C., and J. F. Duguid, M.A., B.Sc.

9/34. No. 930. Analyses of Rhodesian Foodstuffs, by The Division of Chemistry.

4/35. No. 949. Report of the Branch of Chemistry for year ending 31st December, 1934, by A. D. Husband, F.I.C., Chief Chemist.

5/35. No. 954. Experiments on the Toxicity to Fowls of Arsenite of Soda and Poisoned Locusts, by J. K. Chorley, F.R.E.S., and R. McChlery, B.A., B.Sc.

4/36. No. 983. Annual Report of the Branch of Chemistry for year ending 31st December, 1935, by A. D. Husband, F.I.C., Chief Chemist.

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MISCELLANEOUS.

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THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.
(Assisted by the Staff of the Agricultural Department).

PUBLISHED MONTHLY.

Subscription: 5/- per annum; payable to the Accountant, Department of Agriculture, Salisbury.

VOL. XXXV.] FEBRUARY, 1938. [No. 2

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Making Compost without Manure.—The North Kanara district of the Bombay Presidency is very poor in cattle population and the available farmyard manure is not sufficient to meet the needs of the locality. The district, however, has large areas of forest, from which organic material can be obtained in abundance in the form of leaves, droppings and loppings. These are collected by the local cultivator and made use of, in the preparation of manure.

The unusual method is to collect the dry and fallen leaves along with the loppings of the tender branches and to spread this mixture under the feet of cattle as litter for a day or two. The litter is then removed and replaced by a fresh lot from the forest. Several days' collection of the leafy material, well

mixed with the urine and dung of cattle is then stored in pits and allowed to ferment for a period of ten to twelve months. But, as already pointed out, there is a paucity of cattle in this district and it is not always possible for the cultivator to employ this method. Very often the cultivators directly apply to the soil large quantities of fresh leaves without composting them. There was thus a need for a method of composting organic matter in the absence of cattle. Experiments were, therefore, undertaken to prepare organic manure by the use of different types of chemicals as starters. Trials were made not only with the forest material but also with other locally available organic wastes, such as rice husks, betel husks, rice straw, etc. The result of these experiments are embodied in a paper recently published in "Agriculture and Livestock in India."

Method.—Preliminary trials were made with a large number of chemical starters, including Adco Accelerator, Adco Mixture, bonemeal, calcium cyanamide, ammonium sulphate and calcium carbonate. The mixed material obtained from the forest was spread out in a thin layer of three to four inches deep. A solution or suspension of the chemical starters was sprinkled profusely and a second layer of forest material was spread on top and the solution again sprinkled. This process was continued till a height of four to five feet was attained. This heap was placed under shade on an elevated piece of ground, so as to minimise excessive loss of moisture. At intervals of eight to ten days the heap was raked over to ensure sufficient aeration and watered sufficiently to keep up sixty to seventy per cent. moisture. Fermentation was found to be complete in about 90 to 100 days and the final product in each case was well mixed and analysed for nitrogen and fibre.

Judging from the friability, crispness, smell and ripeness the manure obtained by the use of ammonium sulphate and calcium carbonate together was found to be far superior to the others, while Adco mixture was the next best. In all further experiments, therefore, ammonium sulphate in combination with calcium carbonate was employed.

Yield and Cost.—To treat one ton of the leafy material of the forest with 0.3 per cent. nitrogen and five per cent. calcium carbonate thirty-four pounds of ammonium sulphate

and 112 lbs. of calcium carbonate are required in addition to about 500 gallons of water. An equal quantity of water has to be added at the time of the second watering, after about ten days. At subsequent rakings of the heap at intervals of eight to ten days, 150 to 180 gallons of water are sufficient to maintain the moisture content at about seventy per cent. Within a week the temperature rises to about 50°C and gradually comes down after thirty to forty days. After three months the fermentation will be complete and the final material resembles the cultivator's farmyard manure of ten to eleven months' standing, in colour, feel, friability and smell.

Tobacco in India.—According to the report of the Director of the Imperial Research Institute, New Delhi, for 1937, work on the improvement of the tobacco crop was commenced in 1905, attention being paid to all the three main types of tobacco cultivated in India, *i.e.*, cigarette, chewing and *hookah* tobaccos. Sixty-nine types of *N. tabacum* and twenty types of *N. rustica* have been isolated, of which Types 28 and 63 (chewing tobaccos) among the former and Type 18 (*hookah* tobacco) among the latter, are under distribution.

The leaf produced in India is generally of a coarse heavy type with a dark colour and a strong flavour. This type is suitable for the local market and a large amount is also exported mainly to Great Britain, where it is used principally for mixing with other leaf in the preparation of pipe tobaccos. In recent years, however, the principal feature of the leaf tobacco trade of the world has been the large and still increasing demand for the cigarette type of tobacco. As none of the indigenous tobacco varieties was found to be suitable for cigarette production, hybridization between exotic and indigenous varieties was resorted to. From the crosses which were made two strains, H 142 and H 177, have been selected as being very suitable for cigarette manufacture. These combine the fine leaf quality of the foreign tobaccos with the greater hardiness and yield of the indigenous varieties. The Institute has played an important part in the development of a technique of flue-curing of tobacco suitable

for Indian conditions, and the rapid development of the cigarette tobacco industry in the Guntur District of the Madras Presidency has been made possible by the researches conducted at Pusa.

Agricultural Education.—The Agricultural Education Association of Great Britain held its annual luncheon at the Euston Hotel on December 8th, 1937. The Right Hon. W. S. Morrison, M.P., Minister of Agriculture, who is this year President of the Association, was in the chair. The following are extracts from his reply to the toast of "The President":—

"We are realising that in this industry of agriculture the application of practical intelligence to its problems is probably the most important thing we have to accomplish. The research which has taken place in recent years has been most fruitful of results, but the difficulty has always been to bring the laboratory into contact with the farmer.

"The more the research worker and the education officer can mix together and share their problems the better will be the agricultural education in our country. For that reason I welcome this association, which not only brings together by its conferences and gatherings education officers all over the country, but provides that intimate link between research and education which enables, ultimately, the fruits of research to reach the farm.

"Mr. Rambotham, the Minister of Pensions, has spoken of the problems of agricultural education. We at the Ministry are well aware of the structure which has been built up, and which will, I hope, be capable of further development in the future; but I do agree to the necessity of starting at the bottom with elementary education and seeing that it is suitable for the great vocation of agriculture.

"No one can view without misgiving the fact that for the past forty years there has been a steady drift to the towns. I believe housing is a very important contributory factor. The Minister of Health is putting forward proposals which I hope will go some way towards giving the agricultural worker what he must have if he is to remain in the country—a home where he can get married.

"Behind all the causes, however, and going to the root of the matter, is a factor which, I believe, can only be reached by education. We commonly talk of 'agricultural education' as if its only function and purpose were confined to passing on the results of research to farmers. There is something deeper and more profound in the duties which it can perform and the benefits which it can confer on the countryside.

"I am sometimes a little unhappy at an expression we use, namely, 'giving education a rural bias.' It sounds as if we were weighing the scales of education for some commercial or industrial purpose connected with rural industry. The truth is rather the reverse. Education has quite unconsciously been biased for a generation in an urban direction, and what we ought to seek in rural education is to restore the balance to make sure that we are giving a balanced outlook on life to the children who are entrusted to us."

The Grass Fire Evil.

The uncontrolled veld fires, which so regularly sweep across large sections of Southern Rhodesia each dry season, constitute a national menace which the Colony can no longer afford to ignore. While there are occasions when controlled burning of grassland is advisable, nothing but evil can follow in the wake of indiscriminate grass fires.

Although other factors are sometimes responsible, the great majority of these fires owe their origin to human agency, due to ignorance or indifference. All sections of the com munity share in the blame, though not all individuals.

No useful purpose is to be served by endeavouring to determine which section of the population is most blameworthy. The evil exists, and is one which every man, woman, and child in Southern Rhodesia should be taught to recognise and combat. If, as is the case in the great forest countries of the world, veld fires here were attended with serious risk to human life and immovable property, greater importance would already have been attached to them in Southern Rhodesia, and elaborate measures would have been adopted for their prevention.

The British South Africa Police, the Native Department, and the Department of Agriculture have endeavoured—not without some success—to reduce the annual occurrence of these fires, but it is obvious that a much greater and more concerted effort must be made. A widespread appreciation by all sections of the population of the importance of eliminating indiscriminate veld burning, as far as is humanly possible, is necessary for the following reasons:—

(a) *Grass fires undoubtedly contribute* towards marked changes in the composition of the grass population, more particularly where they occur annually over the same sections of country. As a rule, it may be said that winter burning destroys the finer and more nutritious grasses which tend to improve the sward, and thus increases the percentage of bare ground left between the surviving tussocks of the hardier grasses. Many of the better and leafier grasses are unable to establish themselves from seed in bare and unshaded soil.

(*b*) *Grass fires destroy* thousands of tons of semi-nutritious fodder which, if unburnt, would at least have yielded some sustenance to livestock and game, and which could have been put to infinitely better use if, earlier in the year, it had been converted into nutritious hay or vegetable compost. The loss of potential winter feed and of valuable fertilising material, which results from uncontrolled veld burning, amounts to thousands of pounds sterling each year.

(*c*) *Grass fires add immeasurably* to the suffering and mortality amongst cattle and other farm stock, since frequently they occur months before sufficient rain falls to bring on the young grass and maintain it in growing condition. The burning of the veld along main roads and stock-routes often seriously delays the movement of cattle to local markets or for export. The absence of grazing, causes such cattle as are moved to lose heavily in condition, resulting in financial loss to the seller, and poorer quality meat for the consumer.

(*d*) *Grass fires destroy* the cover of decaying vegetable matter which gradually accumulates on the surface of the soil where fires are prevented, and which is so necessary both to the fertility of the land and to the absorption of moisture by the soil, when rains commence.

(*e*) *Grass fires accentuate*, by reason of the removal of the grass cover, the rapid run-off of the early rains, thus encouraging soil erosion and reducing supplies of surface and underground water.

(*f*) *Grass fires increase* the loss of moisture from the soil due to evaporation by sun and wind during the early part of the rainy season, on account of the fact that the shelter and shade which would have been afforded by the long unburnt grass and bush has been removed.

(*g*) *Grass fires destroy* or seriously injure and retard the growth of indigenous timbers, and frequently cause irreparable damage to established plantations of exotic trees.

(*h*) *Grass fires cause heavy mortality* among young game-birds and game-animals, and thus constitute a serious loss to the sportsman and the lover of wild life.

H. G. MUNDY,
Secretary,
Department of Agriculture and Lands.

Irrigation Division.

NOTICE TO FARMERS.

Farmers requiring advice during the coming year on matters relating to Soil Conservation, Irrigation and Water Conservation Schemes, are requested to send in their applications for visits, as soon as possible, to the Director of Irrigation, Box 387, Salisbury, or, if in Matabeleland, to the Irrigation Engineer (Matabeleland), Box 566, Bulawayo.

Farmers are particularly requested not to apply direct to an Engineer while on tour, unless previous application has been made to one of the above addresses. Visits of this nature make it impossible for him to adhere to the dates given to other farmers before the commencement of the tour.

No charge is made for visits if carried out in the course of a tour, provided they do not occupy more than one day.

It is hoped that farmers will endeavour to co-operate with the Department by observing the above points, so that disappointments may, as far as possible, be avoided.

C. L. Robertson,
Director of Irrigation.

DEPARTMENT OF AGRICULTURE AND LANDS.

NOTICE.

VACANCY FOR SHEEP OFFICER.

Applications are hereby invited for the post of Sheep Officer, Government of Southern Rhodesia.

The appointment, which will be subject to Civil Service Rules and Regulations, will be on a contract basis for a period of three (3) years at a salary of from £400 to £500 per annum depending on qualifications, and with annual increments of £25 per annum, subject to satisfactory service. A commuted subsistence allowance of £6 per mensem will be payable, and Government owned motor transport will be provided.

At the expiration of the contract the successful applicant would be eligible for appointment to the permanent staff, provided his services have been satisfactory and provided further that it is then considered that the development of the Sheep Industry in the Colony during the three years justifies such an appointment.

Applicants must have had considerable practical experience in the management of sheep and hold at least the Diploma of the Eight-month Sheep and Wool course at the Grootfontein School of Agriculture, Middleburg, Cape, or the equivalent of this course. The possession of a degree in Agriculture in addition to this qualification would be an advantage.

The successful applicant will be required to produce a satisfactory medical certificate on the prescribed form signed by a Government Medical Officer in Southern Rhodesia, and to assume duty on about the 1st April, 1938.

Applications, accompanied by particulars of age, qualifications, together with copies of testimonials, should be addressed to the Secretary, Department of Agriculture and Lands, P.O. Box 387, Salisbury, and will be received up to the 15th February, 1938.

Canvassing will disqualify applicants.

(Sgd.) H. G. MUNDY, Secretary,
Department of Agriculture and Lands.

Notes on the Cashew Nut.

(*Anacardium occidentale*, Linn.)

By C. K. Brain, Director of Agriculture.

Considerable interest is at present being shown in Cashew culture and several lots of nuts have been introduced into this country recently for the purpose of growing the trees. The Cashew nut tree, an evergreen from 20 to 40 feet high, is a native of Brazil and the English name is derived from the Brazilian "acaju" adopted by the early Portuguese as "caju." It was spread by the Portuguese to various parts of the world, *e.g.*, India about 1560 and was undoubtedly introduced to Africa about that time. In the Mozambique territory, and West Coast, it has become so widely established that it was for a time considered to be a native to those areas. In the United States it only thrives in Florida, and numerous attempts to establish it in California have failed. The tree will not stand much frost and it is seldom found, even in Central America, at elevations higher than 3,000 feet.

It is therefore doubtful whether it will grow satisfactorily anywhere in Southern Rhodesia where frosts occur. Under suitable conditions it produces a large spreading tree with a milky juice, with broad leaves up to 6 inches long and clusters of rosy flowers. It is closely related to the mango, and contains an acrid juice which produces a resin suitable for the manufacture of varnish. The nut is about an inch long, curved and white with an excellent flavour when roasted and salted. It is enclosed in a smooth case which contains an acid, turpentine-like liquid, and this is supported on a large pear-shaped stalk known as the Cashew apple. This is about three inches long when mature, yellowish or red, and is used in Brazil for the production of a wine.

Father J. S. Tavares, who made a careful study of Brazilian fruits, writes that the Cashew tree "furnishes food

and household remedies for the poor, a refreshing beverage for the sick, a sweetmeat for tables richly served, and resin and good timber for industrial uses."

An analysis of the nut made in Hawaii estimated protein 14.43%, ash 2.8%, fat 4.56% and fibre 1.27%.

The readiness with which the Cashew grows and fruits in a semi-wild state has kept it from receiving the horticultural attention which other and more delicate species have enjoyed. In nearly all regions where it is grown it is more common as a naturalised plant than in the fruit garden. It does not object to such treatment, but multiplies rapidly, grows vigorously, and yields abundantly.

According to Sim's Forest Flora of Portuguese East Africa, *Anarcardium occidentale*, L. occurs commonly in the coastal belts; "in fact, it is widely distributed and protected by the natives; and now the most frequent tree in the Province in or near where cultivation is, or has been, practised. Many large areas of abandoned lands are almost pure open forests of this tree, and the natives never cut it down, as it supplies both food and drink."

An account of the culture of Cashew nuts in Southern India was published some time ago which stated: "Cashew-nut trees can be grown successfully on any soil. They thrive in sandy places as well as on stone, and are not fastidious in point of soil, but are generally grown where no other crop can be produced. In this district there are many sand hills, especially below Ghats, which are utilised for this crop. Along sea coasts which are exposed to severe gusts of wind, the plants never attain the form of a tree, but keep along the ground, producing small branches.

Seeds are usually planted in the month of June, at a distance of about 15 feet each way. In many cases this distance proves to be insufficient. The plants are watered the first year only. No other care is taken of them.

The plants begin to bear from the third year and continue till the age of about fifteen, at which stage the trees exude a gummy substance in large quantities and then die."

In other regions the trees live to a greater age than fifteen years. Reports from many parts of the world indicate that they may come into bearing the second or third year.

In Brazil the Cashew flowers in August and September and ripens its fruits from November to February. In Southern India the flowering season is December and January, and the fruit ripens in March. An Indian writer estimates the yield of a mature tree at 115 to 150 pounds of fruit yearly. "To get one maund (28 pounds) of kernels about 1½ candies (115 pounds) of seed nuts are required."

Very few pests have been reported as affecting the Cashew.

Seedling Cashew trees differ in the character and quantity of fruit they yield. In Brazil the trees which produce the largest and finest fruits are distinguished with varietal names. Some of these trees acquire local reputations.

It has been shown that the Cashew can be shield-budded. By employing this method it is easily possible to propagate choice varieties originating as chance seedlings.

The Preservation of Farm Beacons

AND HOW TO MAKE USE OF THE FENCING LAW.

As the provisions of the "Fencing Ordinance, 1904," have been applied to the whole of the Colony, it is competent for any landowner to require his neighbours to join in or contribute to the construction of fences on mutual boundaries, in such proportion as may be agreed upon between them. To this end he should serve a notice in writing on the person he desires to contribute, specifying the boundary to be fenced, the kind of fences and mode of erection proposed (*See specimen letter A.*)

If within three months no agreement is arrived at in respect of any of the above points, the matter is to be settled by arbitration. (*See specimen letter B.*)

If either of the parties fails to carry out any of the work of construction that he has agreed to do, or has been allotted by an arbitrator, the other party may carry it out and recover the share of the cost that the first party should have contributed, in any Court of competent jurisdiction.

The person called upon to contribute to the construction of a dividing fence may, by giving notice within one month of the amount being fixed for which he is liable, pay such amount by equal annual instalments, with interest at 6 per cent. per annum added. (*See specimen letter C2.*) If the capital amount does not exceed £100, the payments may be extended over five years, and if the amount exceeds £100, the payment may be extended over ten years. In a schedule to the Ordinance there is given a table for calculating the amounts payable every year for five or ten-year periods.

When an owner is absent or cannot be found, or any land is unoccupied, the owner of any adjoining land who wishes him to contribute to the cost of a fence must advertise at least once a month for three months in the *Gazette* and a paper

circulating in the district, requiring him to contribute. (*See specimen notice D*). He may then obtain an order from the Magistrate authorising him to proceed with the construction, and in due course a certificate of the amount due by the owner of the adjoining land. This certificate must be lodged with the Registrar of Deeds, who will make an entry in respect of the land affected, which entry will constitute a hypothecation of the land.

Tenants, excepting those whose unexpired term of lease does not exceed one year, are liable to pay interest at the rate of 6 per cent. per annum on half the cost of construction, and tenants who have the right of purchase are liable to have any sum paid by the owner for construction of fence added to the purchase price.

Owners of land on either side of dividing fences are liable for the cost of repairs in equal proportion. An owner can serve on his neighbour a notice requiring him to assist in repairing such fence (*see specimen letter E*), and if the second owner refuses or neglects to do so, after one week the first owner can make the repairs and recover his share from the second. Fences destroyed by accident may be repaired without notice. If the fence is damaged through the neglect of either of the parties, he only is liable for the whole cost of repairs.

The Ordinance does not affect any substantial fence already erected at the time of the coming into operation of the Ordinance.

If the owner of any land shall have erected by 10th December, 1926, a fence on the boundary of his land, and any other person shall adopt any means by which such fence shall be rendered of beneficial use to himself, he shall be liable to pay the owner of the fence interest at 6 per cent. per annum on half the then value of so much of the fence as he makes use of, and shall also be liable for half the cost of repairs.

Any person erecting a fence on land covered with bush is entitled to clear the bush for a width not exceeding six feet on either side of such fence, and to remove any tree

standing in the direct line of such fence. The cost of clearing may be added to the cost of the fence in cases where any part of the cost of the fence is to be recovered from another party.

Where a river forms the boundary of contiguous lands, but is not capable of resisting the trespass of animals liable to be impounded, it shall be competent for the owners to agree upon such a line of fence on either side of the river as shall secure such fence from the action of floods; and in the event of their not agreeing upon such a line of fence, and whether any or what compensation in the shape of an annual payment shall be paid to either party for loss of occupation of land, the question shall be settled by arbitration.

If the owner of any land shall clear the same of inflammable materials for the space of fifteen feet from any boundary fence, and the owner of the contiguous land shall neglect so to clear his land, such owner shall be liable for any damage done to the fence by fire due to such neglect, and is required to make good the damage within one month, failing which the neighbouring owner may make good the damage at the expense of the owner in default.

Every person engaged in constructing or repairing a fence under this Ordinance may enter upon the contiguous lands, if necessary, at any reasonable times and do any reasonable acts thereupon that may be required for the construction or repair of the fence, but he may not enter upon any cultivated ground, garden, plantation or pleasure ground or cut down or lop any fruit or ornamental trees or shrub without the consent of the owner.

Any owner to whom any amount may be due by any person by way of contribution towards the construction of a dividing fence may call upon such person to pass a mortgage bond upon his land. (*See specimen letter F.*) If the said person shall refuse or fail to pass such mortgage bond the owner may notify to the Registrar of Deeds the fact that the amount is owing and no mortgage has been passed. (*See specimen letter G.*) The Registrar of Deeds shall then notify the person named, the fact and particulars of the notification received from the first party, and if no objection is lodged within three weeks the amount of the debt is registered in

the Deeds Office and no transfer or mortgage on the property can be passed until the bond above referred to has been duly passed. Should any objection be raised, no entry shall be made in the Deeds Office registers except with the consent of the said person or upon the order of a competent Court.

An "owner" is described in the Ordinance and amending Act as—

(*a*) Any person, company, co-partnership or public body in actual occupation of or entitled as owner to occupy any land alienated from the British South Africa Company, or entitled by virtue of any certificate or document conferring a right to claim any land from the British South Africa Company.

(*b*) The Council or other governing body of any Municipality or Corporate Town, in respect of all lands to which or to the use of which the inhabitants of such Municipality or Corporate Town have acquired or may hereafter acquire a common right.

(*c*) Any person lawfully occupying or holding land in accordance with the provisions of any agreement, made before or after the taking effect of this Act, empowering the Government to allot lands upon the promise of title, subject to the fulfilment by the allottee of prescribed conditions.

It should be noted that the Government is not amenable to the fencing laws in respect of boundry fences between Crown land and privately owned land and between native reserves and privately owned land, nor is it legally bound to contribute towards the cost of erecting fencing along declared roads passing through privately owned land.

The Government has, however, accepted a limited amount of financial responsibility for the cost of erecting the three above-mentioned types of boundary fences. In other words, sums of money are voted annually in the Votes of the Department of Lands, the Native Department and the Department of Mines and Works, from which claims in respect of boundary and road fences can be met, but only up to the amount voted annually for this purpose.

Applicants desiring Government assistance towards the cost of fencing boundaries between Crown lands and their farms should therefore apply to the Department of Lands, and those desiring to fence between their farms and native reserves, to the Chief Native Commissioner. The Department of Mines and Works should be approached for a contribution towards the cost of fencing along declared roads.

SPECIMEN LETTERS.

A.—Letter calling upon a neighbour to join in the cost of a fence.

Dear Sir,—

I beg to inform you that I propose to erect a dividing fence on the border of this farm and that of...................... and call upon you, in terms of section 6 of the "Fencing Ordinance, 1904," to contribute towards the cost thereof. The line concerned runs from..................to......................

I propose the erection of................(*here state kind of fence to be erected, material, cost, etc.*) and that................. (*here state proposals for erection, by what means, cost, etc.*)

Yours faithfully,

B.—Letter calling upon a neighbour to go to arbitration.

Dear Sir,—

With reference to my letter of......................(see *A*) in view of our failure to arrive at an agreement with regard to ....(*here state points on which no agreement arrived at*), I now propose that the matter should be settled by arbitration in terms of clause 7 of the "Fencing Ordinance, 1904," and have nominated Mr...........................to act as arbitrator on my behalf. Will you please nominate an arbitrator to act for you?

Yours faithfully,

C1.—Letter acknowledging A and agreeing to share expenses.

Dear Sir,—

I have your letter of................regarding the erection of a joint fence, and in reply beg to state that I am prepared

to agree to the terms suggested and to pay half cost of all expenses (*or any other proposals as the case may require*).

Yours faithfully,

C2.—Letter acknowledging A and requesting to pay by instalments.

Dear Sir,—

I have your letter of..................regarding the erection of a joint fence. In reply, I beg to state that I am prepared to agree to the fence suggested, but wish to avail myself of the provisions of section 9 of the "Fencing Ordinance, 1904," and to pay the amount of my share of the cost by instalments, with interest at the rate of 6 per cent. per annum, extending over a period of................years.

Yours faithfully,

(See in reply specimen *F.*)

D.—Notice in Gazette *and Newspaper calling on owner whose address is unknown to contribute.*

To A.B., owner of farm.............................situated in the District of.........................

Take notice that I intend to fence my farm................. and in terms of sections 5 and 11 of the "Fencing Ordinance, 1904," I hereby call upon you to contribute towards the cost of construction of the fencing of our common boundaries from........................to.........................

(Sgd.) C.D.

E.—Letter calling on neighbour to assist in repairing a boundary fence.

Dear Sir,—

I beg to inform you that the boundary fence dividing our farms....................and....................is out of repair (*here state nature and extent of damage*). I therefore beg to call upon you to assist in repairing the same in terms of section 15 of the "Fencing Ordinance, 1904."

Yours faithfully,

F.—Letter calling upon neighbour to pass Mortgage Bond.

Dear Sir,—

I beg to acknowledge your letter of......................(*see specimen C*) and note that you wish to pay your share of the cost of our joint fence by instalments. I am agreeable to this, provided you pass a mortgage bond over your farm in terms of section 29 of the "Fencing Ordinance, 1904" (*or other security can be arranged by mutual agreement*).

Yours faithfully,

G.—Letter to Registrar of Deeds notifying debt owing by neighbour for fencing.

Sir,—

In terms of section 30 of the "Fencing Ordinance, 1904," I beg to notify you of the undermentioned debt incurred in connection with a joint boundary fence between the farms ....and......................., and to request you to register the same in the Register of Deeds.

Name of farm...

Amount owing...

Situation and name of property in respect of which Bond has been demanded............................

Date of the grant or transfer of the said property to the said person ....

The above amount has been agreed upon, *or* ascertained according to law, and the person above named has been duly called upon to pass a mortgage bond and has failed to do so.

I am,

Your obedient servant,

It is remarkable how apathetic is the average land owner in this country in regard to the existence, position and maintenance of the beacons demarcating his property.

In the case of the grant of Crown land, the Government undertakes to point out the beacons to the grantee, and obtains a beacon receipt, which indemnifies the Government from further responsibility in the matter. The conditions of the title deed also include a clause by which the owner is held responsible for the maintenance of his beacons. In the case of transfer of the property, these conditions automatically apply to the transferee, who should first satisfy himself on the other two points, *viz.*, the existence and position of the beacons. This important matter is often forgotten, particularly when the sale of the land has been effected by an agent in an office, when in reality the deed and diagram are sold and bought and not the actual ground which they represent.

The object of this article, however, is to deal rather with the question of the maintenance of beacons.

Although there may be no immediate intention of selling the whole or a portion of a farm, it is a possibility to be borne in mind. Indeed, one has only to observe the land history of any older country to see that it is a probability. In the case of transferring the whole property, the new owner will need to be satisfied that the beacons are in order, and in the case of a sub-division, a survey will be required, and the surveyor's fees will be considerably heavier if the old beacons have first to be re-located and re-erected. Apart from the question of the survey fees, the fact of beacons being allowed to fall into disrepair is liable to cause endless litigation, as has been so often experienced in the Union of South Africa.

The chief trouble in this country, however, is not so much the passive neglect of beacons, but the wilful mutilation and often the outright destruction of beacons owing to the erection of fences. The prevailing custom is for the fencer to remove the beacon altogether, including the iron pin marking its centre, to dig a large hole and to plant the corner pole of the fence therein. The pin and stones may or may not be replaced, but in any case the accuracy is gone, and the new mark is merely "somewhere about" where the original mark

was placed. That beacon has now lost its value as an "original beacon," and is henceforth ignored both by surveyors and by the Court is cases entailing the "evidence of beacons." In other words, the fees paid for the survey of the land are a dead loss to the owner, since he has nothing to show for them but a diagram which may or may not represent the beacons of his ground.

Fig 1

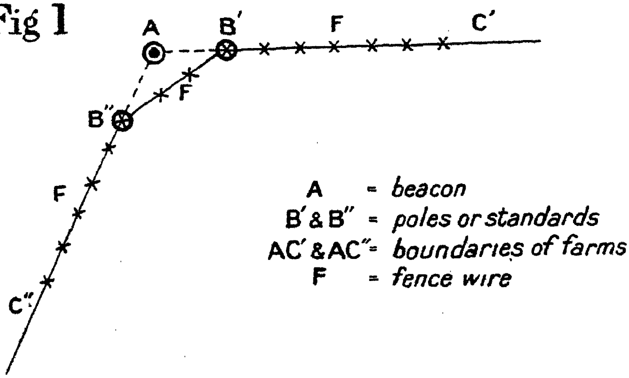
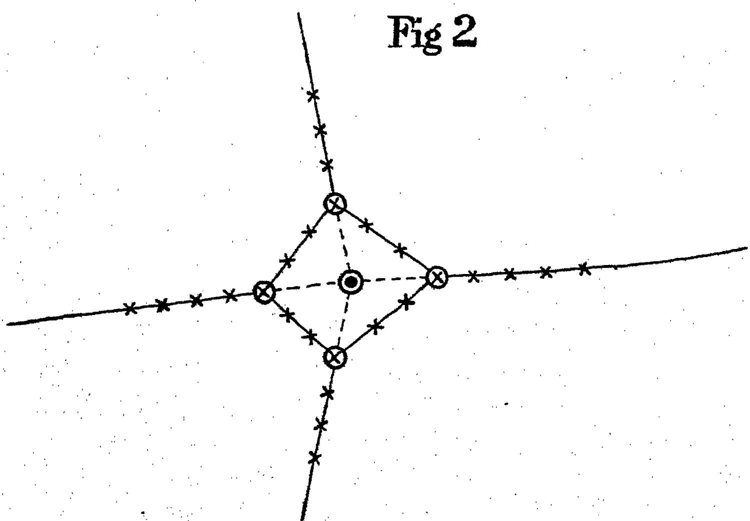


Fig 2



The remedy is simple. Instead of having only one corner fence pole, terminate each line a few feet short of the beacon. (See figure 1.) It might be argued that this means further

expense to an already expensive undertaking, but I understand that it would only be a matter of 7s. or so at each point, and what is 7s. compared with £7 or more, which it would eventually cost to have the point refixed by survey? Also, granting the fact that fencing a farm is an expensive undertaking, the extra outlay of a few shillings would scarcely be noticed, and the advantages accruing would more than compensate for the extra expense.

Referring to figure 1, the distance AB′ and AB″ should not be less than 4 feet, and the wires joining B′ and B″ should never be so close to the beacon as to interfere with its base.

Figure 2 shows the final result in the case of a beacon common to four farms. This beacon is left undisturbed and will remain so for generations—it is a real "landmark," and an indisputable beacon, and is automatically preserved by the enclosing wires.

If, therefore, farmers would bear this matter in mind and insist on this procedure when arranging for the fencing of their farms, they would save money, fulfil their obligations as to the maintenance of their beacons, and, at the same time, be doing a real service to Rhodesia in preserving such marks, which would be used as controls in the closer mapping of the country which must ultimately be undertaken.

Pig Industry Act, 1937.

AN EXPLANATION OF CERTAIN PROVISIONS OF THE ACT.

Division of Animal Husbandry.

The Grading of Pigs.—From February 7th, 1938, all bacon pigs will be graded and be paid for according to a scale of prices recommended by the Pig Industry Board and approved by the Minister of Agriculture and Lands.

Regulations for the grading and marking of pigs were published as Government Notice No. 12 of 1938 and the scale of minimum prices was published as Government Notice No. 54 of 1938. The conditions required in these notices and the reasons for them are, however, set forth in more detail in this pamphlet.

Marking of Pigs.—In the first place all baconers and pigs for export as frozen carcases will have to be marked by the seller with an ear tag bearing his registered number. A supply of these tags ready marked with the seller's registration number can be obtained from the Secretary, Pig Industry Board, P.O. Box 592, Salisbury.

The tag must be affixed carefully to the right ear of the pig and care must be taken to see that the piercing point engages with the slot on the other side when the tag is pressed closed. The tag should be tested to see that it is properly affixed before the pig is released.

Pigs for slaughter in the local market as pork need not be marked at present.

Any producer who has not yet registered with the Pig Industry Board and obtained his registered number should do so at once. Unmarked pigs may not be graded and would, therefore, not participate in the benefits of the minimum price arrangements, besides incurring legal penalties.

Native pig producers who wish to sell baconers for local consumption or pigs for export as frozen carcases should apply in person to the Native Commissioner of the district in which they reside for registration. Those native producers selling porkers in the local market need not register at present.

The Grading of Bacon Pigs.—Bacon pigs are graded chiefly on the depth of back fat. This depth is determined after the carcase is split. There is an optimum depth of back-fat and a maximum allowance for each weight of pig. The measurements required are set forth at the end of this section. These standards are based on the international standard for Wiltshire sides but have been made easier to suit Rhodesian conditions at the present stage. They may be tightened up later when the general standard of pigs in the Colony has improved.

It will be noted that the depth of back-fat is measured in three places—over the middle of the back, top of the shoulder and over the rump or loin. The important measurement is the back measurement, which gives the best indication of the stage of development reached by the pig at the time it is slaughtered. The depth of fat must be within the maximum measurement allowed here for the grade as well as at any one of the other two points. Thus a pig weighing 170 lbs. and measuring $1\frac{1}{4}$ inch at the middle of the back, $2\frac{1}{4}$ inch on the shoulder and $1\frac{1}{2}$ inch on the loin would grade "C" (Standard). As, thought the middle of the back measurement would be correct for Grade B (Choice), both the other measurements fall into Grade C (Standard).

The sides are not actually measured, as the grader is supplied with a special gauge which can be fitted against the back after the carcase has been split. The grading is carried out by a Government Grader.

A certain thickness of belly is also required This is measured with another type of gauge. This thickness is required to give a satisfactory cut of streaky bacon. A cut of $\frac{1}{8}$d. per pound liveweight is made in the grade price off any pig which shows an insufficient development of the belly. Further, cuts of $\frac{1}{8}$d. per pound liveweight may be made also for baconers showing seedy cut, which necessitates heavy trimming of the belly, or with very deficient hams, as illustrated in figure 1.

Certain classes of pigs specified at the end of this section cannot be included in any of the foregoing grades. The most common of these pigs is the "soft pig," and a pig which kills out soft cannot, therefore, be made into a selected, choice or standard side.

The grading is carried out after the pig is slaughtered and the grader identifies the carcases from the serial number stamped on it by the curer. A copy of the grading returns is sent to each seller. From these returns it can be seen exactly how the pigs have graded and where, if at all, they are deficient. This information is one of the chief benefits of a grading system, as it enables the producer to find out accurately in what way either by breeding, management or feeding, the efficiency of his herd can be raised.

Schedules.—For the period 7th February, 1938, to August 31st, 1938, the prices of bacon pigs delivered at the factory have been fixed as follows:—

Grade A—Selected	...	$4\frac{5}{8}$d. per lb. liveweight.
Grade B—Choice...	...	$4\frac{1}{8}$d. per lb. liveweight.
Grace C—Standard	...	$3\frac{3}{4}$d. per lb. liveweight.

These prices are net to the producer and the levy of $\frac{1}{8}$d. per pound payable under Government Notice 852 of 1937 must be paid by the slaughterer. A cut of $\frac{1}{8}$d. per lb. liveweight in these prices may be made for each deficiency if the carcase shows:—

(*a*) Deficient belly.
(*b*) Seedy cut.
(*c*) Deficient hams.

The prices have only been fixed for a period of six months to start with, as it is necessary to study their effect before committing the industry for a long period.

No price is fixed for pigs which are not classified in these three grades. They are graded and marked X and the curer can purchase them at whatever he considers a reasonable price. If they are not required by the factory, producers will have to dispose of them on the local market as pork, the price of which is not fixed. No producer, with a reasonable stamp of pig, intelligently fed, should have trouble, however, in securing at least the choice or standard grades for his output.

Some time must elapse before it is known how producers will fare under the prices fixed. A producer, however, whose pigs grade 50 per cent. select and 50 per cent. choice may average a net return of $4\frac{3}{8}$d. per lb. liveweight, which is considered a satisfactory return under local conditions.

A surplus of bacon pigs for local consumption may arise under the stimulus of these fixed prices. If the surplus falls within the three grades specified in the foregoing paragraphs it will be possible, however, if the necessity arises, for the Board to arrange for the export of such surplus to the United Kingdom as frozen baconers. The Board will pay the fixed price for those pigs, but they must be delivered to the Board at Bulawayo, the producer paying railage. When the trade justifies it, the Board may appoint an agent at two or three forwarding centres to forward the pigs to Bulawayo on behalf of the producers and save railage by combining shipments.

Producers, for the time being, will therefore of necessity secure a slightly lower net return on any pigs surplus to the requirements of the local factories, but they will still have a certain market for all good baconers. Any pigs, however, which do not make at least the "Standard" grade after slaughter, will not be accepted by the Board but will be rejected and sold to the best advantage on the local market at the risk of the producer, who will be credited with the proceeds less costs.

It is hoped, however, in the early stages, to direct the expansion of the industry into the production of porkers for export and so prevent a surplus of bacon pigs, which will be more difficult to handle under existing local conditions. For

this reason a comparatively attractive price is offered for porkers suitable for export and careful watch will be kept on the trend of production and producers will be warned if a surplus of baconers seems likely.

Grading Measurements.—Baconers for curing into bacon for sale within the Colony shall be graded by the Government grader after slaughter, as follows:—

Grade.	Class 1. 160-179 lbs. (liveweight). Fat Measurements.	Class 2. 180-214 lbs. (liveweight).
A (*Selected*)—		
Middle of back ...	Max. 1 3-16 in.	1 5-16 in.
	Min. $\frac{3}{4}$ in.	$\frac{3}{4}$ in.
and either shoulder	Max. 2 in.	$2\frac{1}{8}$ in.
or loin...	Max. 13-16 in.	1 5-16 in.
and belly	Min. $1\frac{1}{4}$ in.	1 6-16 in.
B (*Choice*)—		
Middle of back ...	Max. 1 6-16 in.	$1\frac{1}{2}$ in.
	Min. $\frac{3}{4}$ in.	$\frac{3}{4}$ in.
and either shoulder	Max. 2 3-16 in.	2 5-16 in.
or loin...	Max. 1 6-16 in.	$1\frac{1}{2}$ in.
and belly	Min. $1\frac{1}{4}$ in.	1 6-16 in.
C (*Standard*)—		
Middle of back ...	Max. $1\frac{1}{2}$ in.	1 10-16 in.
	Min. $\frac{3}{4}$ in.	$\frac{3}{4}$ in.
and either shoulder	Max. 2 5-16 in.	2 7-16 in.
or loin...	Max. $1\frac{1}{2}$ in.	1 10-16 in.
and belly	Min. $1\frac{1}{4}$ in.	1 6-16 in.

Any pig which cannot be placed in grades A, B or C, on account of exceeding the maximum measurements (or having less than the minimum back-fat), or which:—

(*a*) has not firm white fat;
(*b*) is malformed or emaciated;
(*c*) in the case of a male pig was not castrated within 12 weeks after birth or is a rig pig, sow or pregnant pig, or, in the case of a gilt not a maiden gilt;
(*d*) pigs suffering from disease or injury.

General.—Every pig shall be deemed to be within the highest grade applicable to its measurements.

Prices for Porkers for Export.—As soon as supplies of pigs on the local market return to normal the Board will pay $5\frac{1}{4}$d. per pound liveweight to approved producers, who contract with the Board to deliver pigs for export, for suitable porkers delivered at the Bulawayo works. Railage to Bulawayo must be paid by the sender and no price is guaranteed for rejects. The Board will, however, dispose of rejects to the best advantage on the local market and credit the producer with the proceeds, less costs.

In order to limit the number of rejects it is proposed to obtain all the supplies of porkers for export from approved producers to start with. An approved producer is one whose herd of pigs is of a suitable standard and who agrees to feed the porkers on lines laid down by the Board. Where a producer is not known to the Board arrangements will be made to inspect his herd. Such approved producers will contract with the Board to supply pigs within stated periods and will be paid the price of $5\frac{1}{4}$d. per lb. liveweight for all suitable pigs. Judging from past experience the percentage of rejects will be small from approved herds.

Any producer who is interested in the export of frozen porkers and would like to be registered as an approved producer should communicate with the Secretary, Pig Industry Board, P.O. Box 592, Salisbury, as soon as possible.

The conditions laid down for feeding will not be onerous. Oily feeds must be cut out and the young pigs must receive an adequate allowance of either separated milk or meat and blood meal. The pigs must be fed sufficiently well to make the required weight for export (85-100 lbs. liveweight delivered at the factory) at under five months of age. The other details of management and feed are left to the discretion of the producer, though the Animal Husbandry Division of the Department of Agriculture will always be ready to give more detailed recommendations where required. Bulletin No. 1049 of the Department of Agriculture summarises fully the results of the first five shipments of porkers, and gives particulars of feeding. It can be obtained from the Editor, *Rhodesia Agricultural Journal*, Salisbury, at a cost of 3d.

The general standard for export of frozen baconers and porkers has been specified as follows in Government Notice No. 12 of 1938:—

> "Porkers and baconers for export overseas shall be graded after slaughter and shall comply with the following requirements: 'they shall be clean, fresh in colour, properly dressed and well frozen; the skin shall be smooth; there shall be no detrimental bruises or weals; the bone shall be fine; the shoulders shall be light; the body shall be of good length in proportion of the weight of the carcase; the hams shall be well filled and the legs shall be short.' "

In addition to these requirements "contract pigs" will have to conform to any breed, feed, or age limitations laid down for the time being in the contract made with the producer.

The general conformation of either a good porker or baconer carcase is shown in the photographic scale in figure 1. Attention is particularly directed to the light shoulders and full hams of the "full marks" pig and the deficient hams and heavy shoulders of the "low marks" pig.

All pigs for export must be sent to Bulawayo for slaughter. This provision may cause comment in certain areas of the Colony, but the Bulawayo Factory is the only one at present suitably equipped for export. As the trade develops it may be possible to make arrangements to slaughter at other centres. Both the terms of the Cold Storage Agreement and practical considerations will, however, make it necessary to confiine the export trade to Bulawayo for some time to come. Porkers can be sent without serious difficulty to Bulawayo from any point in the Colony close to the rail, and if arrangements are made to combine shipments and, if necessary, to partition the railway trucks, the cost of the railage to Bulawayo at export rates will not be unduly burdensome to producers.

Further particulars in regard to the operations of the Pig Industry Act can be obtained from the Chief Animal Husbandry Officer or the Secretary of the Pig Industry Board.

Standard for award of Marks. Shoulders and Hams.

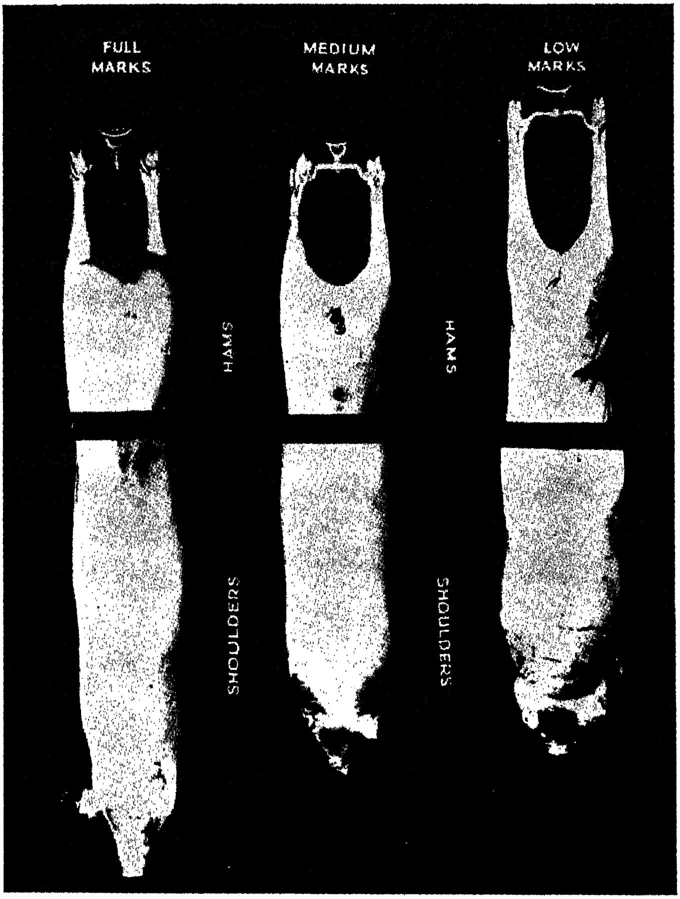


Figure 1.—Photographic scale of shoulders and hams which shows the shape for maximum, minimum and intermediate marks.

(Reprinted from "The Pig Breeders' Annual," 1936-37, from photographs by Jos. B. Swain.)

Army Worm.

Reports of the outbreak of Army Worm this season have been received since 22nd December. Whilst the outbreak has been neither as large nor as widespread as in 1929-30, it has been of a more serious nature than during any subsequent season. The 1929-30 outbreak, like the present one, commenced early.

In the experience of the Department, the early outbreaks have always been more serious than the late ones, and two destructive generations in one season have not yet been recorded in this Colony. However, sufficient evidence has not yet been accumulated to enable the Department to reassure the public that there will not be a second outbreak of Army Worm this season, caused by the progeny of the first. There is no desire to alarm the public unduly, but merely a desire for farmers to be on the alert in case a second generation should take them unawares.

This pest is thought to be migratory, the moths covering large distances, perhaps hundreds of miles, in flight from one locality to another.

Most Rhodesian maize growers are only too familiar with Army Worm. The caterpillars measure in length up to about one and a half inches. They are smooth and predominantly dark green or black in colour, with some yellow and pale green longitudinal stripes on the sides. Their favourite food is sweet grasses, cereals and young maize. Crops other than those belonging to the grass family seem rarely to be attacked.

A pamphlet (Department Bulletin No. 796) on the subject of Army Worm is obtainable from this Department.

An outbreak of Army Worm at the present time would not be so serious a matter to maize farmers as if it occurred earlier in the season, when the maize is young, but young cereals, teff grass, etc., are liable to suffer seriously.

Clean cultivation in maize lands is a precaution against development of the pest actually in the crops, as the moths

are extremely liable to lay eggs on rapoko grass (*Eleusine indica*), but as far as is known do not lay on maize plants, except when the plants are very young or when very young suckers are present.

Methods which may be used to protect crops or to destroy Army Worm are as follows:—

1. **Poisoned Bait.**—Chopped green stuff dipped in arsenite of soda 1 lb., cheapest sugar 2 lbs., water 16 gallons (four paraffin tins) makes a useful poisoned bait. The arsenite and the sugar should be dissolved in the water and the green stuff then dipped and drained. The bait can be spread, if possible on bare ground, in front of an advancing "army" at the rate of about 100 lbs., per acre. Sixteen gallons should wet 200 lbs. of chopped green stuff.

2. **Locust Poison.**—The caterpillars are readily destroyed by spraying with locust poison as used against locusts, namely, 3 ozs. of arsenite of soda powder to one petrol tin (four gallons) of water. Spraying the grass in front of an advancing swarm is also useful. Cattle dip (1-400 strength) can be used in place of arsenite of soda, mixing 4 fluid ozs. to a petrol tin of water.

Caution.—Keep stock away from sprayed veld until a heavy shower of rain has fallen.

3. **Trenches** about 18 inches square in section, with a perpendicular or overhanging wall towards the crops to be protected, are useful. Green stuff is usually strewn at the bottom and sprayed occasionally with locust poison.

Failing such a trench, which is laborious to dig, several furrows ploughed across the front of the advancing "army" and strewn heavily with bait as above make a good protective barrier.

4. **Spraying Crops.**—This is usually considered too expensive in practice. Arsenite of lead at a strength of 1 lb. in 30 gallons of water can be used. The addition of a spreader adds to its efficiency. Needless to say, arsenite of soda cannot be applied to growing crops without serious injury.

5. **Mechanical Destruction.**—Labourers can be sent through an infested crop to disturb the caterpillars, which then fall to the ground, where they can be trodden on or otherwise destroyed. It is probably best not to aim at 100 per cent. destruction, but to work quickly through the land killing the majority of the caterpillars and so reducing the damage.

Brush drags can be used on bare ground to some advantage in favourable circumstances, and, of course, beating with branches is a common practice.

Caution.—It must never be forgotten that arsenite of soda and other compounds of arsenic are extremely poisonous, and the greatest care must be observed to keep stock away from sprayed veld until it has been cleaned by rain, and to avoid the possibility of accidents which might endanger human life. Arsenite of soda powder spilled on the soil might be eaten by children, European or native, and will almost certainly be licked up with fatal results by any grazing animals which have access to it. Keep all poison supplies under lock and key, see that any bait is completely utilised or destroyed and use ordinary common sense in dealing with the poison. A solution of arsenite of soda is caustic to the skin and contact should be avoided as far as possible.

Chicken Pox.

(Adapted from an article by J. D. W. A. COLES, Veterinary Officer, Pretoria, in *Farming in South Africa*, May, 1937.)

Chicken pox is a contagious disease widespread in its occurrence wherever poultry are kept. It is the cause of very heavy losses.

An Important Point.—An important point to be emphasised is that chicken pox is not the same as roup (infectious coryza). Only in very recent years has this fact been realised. Roup never shows scabs on the comb, wattles or skin, and the chicken pox vaccine will *not* immunise against it. Owing to past confusion, these two distinct diseases have been known by various names, such as cold, catarrh, roup, diphtheria, diphtheritic roup, canker, swollen head and swollen eye.

It is true that some cases of chicken pox show the lesions of roup only, but some fowls in the flock are almost certain to show the typical pustules and scabs on the comb, etc., if the disease is really chicken pox.

The Cause.—Chicken pox is due to a very small organism which can only be seen distinctly with the best miscroscopes. The organism enters a body cell and there multiplies to form a "colony" of hundreds of the organisms, actually within the cell. The organisms can be stained by special methods and are now even able to be grown outside the body.

Occurrence of the Disease.—Chicken pox may occur throughout the whole year, but usually is at its worst from September to February. Cases in early spring are usually in young chickens, whereas those in January and February are confined mainly to pullets bitten on the comb by mosquitoes when just coming into lay.

The disease is essentially one of young birds, but even old hens may be affected. A recovered bird is usually immune for life.

Apart from transmission by mosquitoes and blood-sucking flies, the organisms can enter the susceptible fowls through small lesions in the mouth or through small wounds in the skin, due to fighting, etc.

Turkeys are very susceptible to chicken pox. Pigeons sometimes contract the disease, but usually suffer from pigeon pox, which is caused by another variety of the organism. Anything that lowers the vitality of a fowl makes it more susceptible to chicken pox. Such conditions are bad hygiene, exposure to cold wet weather, infestation with lice, red mite, tampans and worms, and bad feeding. If white maize is fed instead of yellow, and green food is scarce, chicken pox will be more dangerous.

Symptoms.—These are well known. Most people have seen the small whitish yellow pustules that develop later into the brown wart-like growths on the comb and wattles. There may be discharge from the nostrils, little whitish spots in the mouth, swollen and closed-up eyes, and even the common condition known as the "pip," which is a hardening of the tip of the tongue due to the fowl breathing through the mouth. If the nose is open a fowl will not develop the "pip." Cases have been described where fowls showed only a little nasal discharge, but were ill and got "light" and finally died.

As in roup, a fowl may die of suffocation due to the entrance to the windpipe being blocked by a bit of yellowish diphtheritic material.

In odd cases the wart-like growths, following pustules, may be seen on the skin almost all over the body, especially the legs.

Treatment.—When the lesions are almost confined to the comb they can be treated with tincture of iodine, after the pustules have been opened. If the eyes and mouth are badly affected or the skin shows extensive lesions, it is far better to kill the bird. Occasional white particles in the mouth can be removed and the lesions then painted with tincture of iodine, and if the eyes are not bad they can we washed twice daily with a 1 in 2,000 copper sulphate solution. People handling sick birds should not handle healthy ones, and it is absolutely essential to isolate sick from healthy fowls. Fowl-

pox organisms can live in the soil for a few months, and are carried on the hands, clothing, and shoes of people coming in contact with cases of the disease.

Preventive Measures.—(*a*) Always be on the look-out for cases of chicken pox, and do not hesitate to kill and burn diseased birds, unless the number affected is so large that the owner feels he must attempt to treat them. Treatment is most successful when the lesions are confined to the skin.

(*b*) Correct defects in the hygiene.

(*c*) Feed properly and supply a sufficiency of vitamin A which occurs in green food and yellow maize. Sour skim milk helps to build body vigour.

(*d*) Control internal and external parasites, including mosquitoes.

(*e*) Provide pure uncontaminated water.

(*f*) Isolate for at least two weeks all newly-purchased fowls and turkeys, and those returning from shows and competitions.

(*g*) Vaccinate regularly; this is the most important measure.

Immunisation.—If chickens are vaccinated when in good health and being well fed, etc., they should not suffer from the process. Rarely, however, they show temporary retardation of growth, but the experience is that such chickens are indistinguishable from the others by the time they are four to five months old. If the fowls are inoculated when over three months old, they may go light and not lay well, but such cases are most unusual. Contrary to popular belief, there is no evidence to suggest that annual inoculation leads to the establishment of chicken pox on a farm. When all susceptible birds are inoculated more or less at the same time, the infection seems to die out very soon.

Generally speaking, vaccination should be done when the chicks are 2 to 6 weeks old, but even day-old chicks can be vaccinated.

Chicken pox vaccine is issued by the Director of Veterinary Research, Salisbury, in 50 dose bottles at a cost of 3s., and should be used not later than 7 days after receipt. Do not expose it to direct sunlight. Bottles must not be kept in a vertical position, as a sediment forms which is difficult to break up by shaking. Store bottles lying flat. Shake the bottle very well before use, breaking up any sediment.

Instruct an assistant to hold the bird to be vaccinated on its side with the feet towards the operator. Grasp the upper foot and pull the leg out straight. To obtain open feathers follicles, remove a dozen feathers on the outside of the thigh, by plucking. *Disinfectants must on no account be used.* Rub the plucked area with the end of the glass rod to which adheres a drop of vaccine. Keep stirring the vaccine. After every five chickens, wash the glass rod in hot water and *dry it thoroughly* before continuing with the operation.

Reacting birds show swelling of the vaccinated feathers follicles after three or more days. Usually no constitutional symptoms are noted. Later the follicles regain their normal size, and a thin layer of skin is shed at the vaccination site.

Vaccination will not cure, but only prevent chicken pox, and cannot be expected to help much if most of the fowls in a flock are affected, since it takes at least 14 days for immunity to develop.

Although every care is taken in the preparation of the vaccine, the Department accepts no responsibility for any ill-effects which may occur as a result of its use.

How to make Tobacco-Wash on the Farm.

By M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.

The Commercial Product.—Commercial tobacco extracts are usually purchased in the form of nicotine sulphate. For its manufacture this extract requires a considerable plant and technically trained personnel; manufacture cannot economically be carried out on a small scale. Advantages of the commercial product are that a spray can be prepared at short notice, and that the strength of the concentrate is known, and, therefore, dilutions of known concentration can be readily made. As commercial extracts are sold in several concentrations, the directions issued by the manufacturers on their containers should be followed when a spray is being prepared for use. In order to obtain the full value of the nicotine, soap is added to the spray solution before it is applied to the tree. The soap liberates the nicotine from its salt and also increases the efficacy of the spray in other ways.

The Home Product.—The manufacture of water infusions of tobacco on the farm is simple. A disadvantage of such infusions is that the nicotine content of the final product is not known and is not easily determined, except by chemical methods. However, an extremely strong overdose of nicotine has been found to be harmless to plants. If, therefore, one knows the approximate nicotine content of the type of tobacco used, the formula for an effective wash, containing not less than the required proportion of nicotine, can be calculated. As the nicotine in a water infusion is not chemically combined in a salt, but is free, the addition of soap is less necessary. It is nevertheless highly desirable, as it assists in spreading the spray solution, carries it into the insect's breathing tubes, and, in itself, has certain insecticidal properties.

The proportion of nicotine in Rhodesian flue-cured tobacco leaf averages about 2.1% to 2.2%. It can therefore be assumed that, for general application, the nicotine content of Rhodesian flue-cured tobacco leaf is approximately 1.9%. Comparatively few samples are below this figure.

The chief use of home-made tobacco-wash is for the spraying of aphids. Owing to their rapid rate of breeding these insects seem to appear suddenly. They usually become troublesome during a dry spell in the rainy season, and during autumn and spring. The nicotine content of a spray used for controlling aphis should not be less than 0.05%. Convenient formulae for making a tobacco-wash of not less than this strength from Rhodesian tobacco are as follows:—

	Tobacco.	Water.
1. Virginia flue-cured leaf	10 lbs.	20 gals.
2. Virginia flue-cured trash and clean sweepings	20 lbs.	20 gals.
3. Fire-cured leaf	5 lbs.	20 gals.
4. Fire-cured trash and clean sweepings	10 lbs.	20 gals.

If the tobacco is thought to be of unusually low nicotine content, larger quantities can safely be used.

Cold Infusion.—To make the wash simply soak the loosened tobacco in cold water for 24 hours with occasional prodding or stirring, and strain off the liquid through muslin or other fine gauze to free it of small pieces of tobacco or dirt that may foul the nozzle of the spray pump. About 16 or 17 gallons of liquid will be recovered if the sodden tobacco is squeezed, and this will contain about 60% of the nicotine that was present in the tobacco. Add water or soap solution to make up to 20 gallons. The wash should be used while in a fresh condition. It should be sprayed on to the plants as a very fine mist, and all the surfaces of the plant should be made wet with it. Proper wetting is one of the functions of the soap. Aphids not touched with the spray are not likely to be affected by it. The proportion of soap in the spray should be at the rate of 1 lb. to 20 gallons. To obtain the best results a good pump fitted with a suitable fine nozzle should be used. A metal extension should be fitted to the pump, as this considerably

improves the application of the spray and makes it easier to cover the undersides of the leaves.

Hot Infusion.—When home-made tobacco-wash made with cold water is sprayed on solanaceous plants such as potato, tomato or tobacco, there is danger of transmitting certain tobacco diseases to the plants. If, however, the infusion is made by placing the tobacco in boiling water and allowing the mixture to simmer for an hour (instead of soaking it cold for a day), the disease organisms will be killed. The tobacco should be prodded with a stick while it is soaking.

A certain amount of nicotine will be lost by the use of the hot method, but tests carried out recently in Salisbury show that if the liquid recovered be used at full strength strength instead of being made up to 20 gallons, it will contain not less than the required amount of nicotine. In this case the total amount of spray obtained from 20 gallons of water will be about 13 or 14 gallons (containing about 45% of the original nicotine) and this will need about 10 ozs. of soap. The addition of soap in the hot infusion method can be effected by setting aside a sufficient quantity of the original boiling water to make the soap solution and adding this solution to the wash after the latter has been strained off the tobacco. The hot infusion is more effective if used as soon as it is cool enough to handle.

Warning.—Tobacco-wash made by either of the above methods should not be mixed with Bordeaux mixture, as free nicotine and Bordeaux are not compatible. If a mixture of Bordeaux and nicotine is required a proprietary nicotine sulphate should be used as the source of nicotine. The same remarks apply to other copper spray mixtures.

Storage of Tobacco.—Farmers, whether tobacco growers or not, who keep tobacco for the home manufacture of tobacco-wash, should not keep more than they are likely to need for the ensuing season. The tobacco should be kept in closed containers that can easily be sealed and fumigated, in order to prevent the development and dissemination of pests of stored tobacco. A 40 gallon drum with one end cut out is a useful container. A sheet-iron lid can be weighted down on a gasket made out of the inner tube of a motor car tyre, which rests on the mouth of the drum.

One fluid ounce (or two tablespoonfuls) of carbon bisulphide* poured, or placed in a saucer, on top of the tobacco will be sufficient for each fumigation, and will cost about twopence. As a safe precautionary measure, fumigation should be carried out in early August, in late October, and once or twice in the autumn during warm weather. Whilst all farmers who keep tobacco for making sprays are urged to pay particular attention to keeping their supply free of pests, tobacco growers, especially, are warned that infestation in their premises might lead to quarantine under the "Tobacco Pest Suppression Act, 1933."

*Carbon bisulphide is a heavy volatile liquid and is poisonous and inflammable. Its vapour is explosive when mixed with air. The chemical should be handled and stored with care. The above dose should not be used for fumigating seed.

A Poison Bait for Young Locust Hoppers.

Poison-baiting with a mixture of arsenite of soda ("locust poison") and maize meal against Red Locust hoppers has been reported successful in the Union of South Africa, and is becoming a standard official method of control. Some preliminary experiments have been carried out by officers of the Department of Agriculture in Southern Rhodesia at various times. Promising results were obtained against young hoppers in standing crops, where spraying with a solution of arsenite of soda is undesirable.

Those who wish to try the bait in their lands, or elsewhere, should adopt the procedure described below.

Mixing the Dry Ingredients.—Mix thoroughly two pounds weight of fine arsenite of soda powder with 98 lbs. of maize meal. The poison should be finely powdered and dry, and should contain no lumps. The meal, also, should be dry and without lumps. A bait that is considered more effective consists of three pounds of fine arsenite of soda to 97 lbs. of maize *bran* that has been ground to the fineness of wheat bran.

Moistening.—It is advisable not to moisten the bait long before one expects to use it, since the bait gives the best results if scattered immediately after moistening. Spread the bait amongst the locusts in as wet a state as possible, without having it so wet as to fall in lumps.

Moisten the bait in a metal trough or drum, on a buck-sail, on a wooden floor, or on the ground. It will not matter if a small amount of soil gets mixed with the bait. Any article used in moistening the bait will contain poison and should therefore be thoroughly washed. If the bait is moistened on the ground, the place so used must be well dug over to bury the poison that has soaked into it.

In moistening the bait, follow the methods employed in mixing sand and lime for building purposes. Throw the dry

bait on the bucksail in a heap. *First of all mix the dry bait thoroughly* by working it over with shovels.

Make a cavity in the top of the heap and pour a portion of the water into it. Work the water in by means of the shovels. Then add the rest of the water and continue working over until all parts are well moistened. If any lumps are formed break them up by means of the shovels.

Store the moistened bait in the shade or keep it covered with wet bags.

Amount of Water to be Added.—Use sufficient water to moisten the bait thoroughly but do not soak it in water. When the bait has been properly moistened, a handful when squeezed gently should produce five or six drops of water only.

For 100 lb. of bait about 8 to 10 gallons of water will be required, depending upon the nature of the bait carrier.

Spreading.—The bait is expensive, therefore use the minimum amount required. *If too much is spread there is danger of stock poisoning.*

The amount required per acre will vary according to the height and density of the vegetation. On comparatively bare ground, or in vegetation up to one foot in height, about 60 lbs. of maize meal bait will be sufficient. In tall, dense vegetation the dosage may have to be increased to 120 lb. maize meal (dry weight) per acre.

An acre is approximately 80 yards by 60 yards.

Spread the bait thinly and evenly over the area occupied by the band of hoppers. The method followed in broadcasting wheat seed is the best: Take a handful of bait and spread half on your right side. To do this easily, the first movement of the arm must be made with the left foot going forward, opening the thumb and the first two fingers. To spread on the left side the second movement of the arm must be made while the last two fingers are opened, and should coincide with the forward movement of the right foot. One handful should be sufficient for the two movements. Too much bait should not be taken in the hand. One man can spread a strip about 8 yards wide. Where a large band is treated, the spreaders

should, therefore, be at least 8 yards apart. *Lumps and small heaps are extremely dangerous to live stock.* Spreading should, therefore, be done carefully so as to leave no chance of cattle picking up bait.

When the dosage per acre has to be increased, do not attempt to do this by taking larger handfuls, as this will result in dropping lumps of bait. Rather place the spreaders closer together, so that their baiting strips overlap, as required.

In spreading bait for the destruction of hoppers of the red locust, it is desirable, especially in tall, dense vegetation, to throw the bait with some force, so that the particles of bait may stick to the foliage of the plants. The burning that will result on growing crops will do some damage, but much less than that caused by spraying.

The hoppers often pack in very dense masses on a few bushes, when camping for the night. It is a mistake to put a large amount of bait in these dense clusters and to neglect the surrounding places where the hoppers are more thinly scattered. It is important to bait the whole area occupied by the hoppers uniformly; those in the dense clusters will spread out before they begin to feed.

Also bait a narrow strip of ground all around the band of hoppers, say, 3 yards wide if the band is about 15 yards wide, and a narrower strip in the case of smaller bands, but do not economise too much in this direction.

When should Bait be Spread?—It is of the utmost importance to note that the bait cannot be employed against hoppers of the red locust in the same way as it is used against the brown locust. When the red locust hoppers are on the march, during the warm parts of the day, *they cannot be stopped by scattering the bait amongst them.* They will not stop to feed on it.

Therefore, in baiting hoppers of the red locust, *spread the bait when the hoppers are least active,* that is, late in the afternoon, during the night, or early in the morning. Try to disturb the hoppers as little as possible. If the band is small or narrow enough, it is better not to walk through it, but to scatter the bait amongst the hoppers from the edge of the

area occupied by them. They will drop to the ground as the bait is scattered, but this does not matter; after the work has ceased they will gradually climb on to the plants again.

It is useless to spread bait during rain or when heavy rain is likely to fall within a few hours. Cloudy weather will in itself have no adverse effect on the efficacy of the bait, and a very slight drizzle will also not do much harm. During very cold weather the hoppers will not feed on the bait to any extent. The presence of dew is an advantage, since it keeps the bait moist and tends to make the hoppers less active, so that they remain for a longer period on the baited area.

Age of Hoppers to be Baited.—During the first 24 hours after they emerge from the egg the hoppers do not feed, therefore the bait will not be effective against hoppers under 24 hours old. It is, however, very desirable to bait the hoppers on the egg-deposit or very close to it. Hatching usually continues for a number of days from the same egg-package. Therefore the egg-deposit should be kept under observation, and bait should be applied as soon as large numbers of hoppers are present that are 24 hours old, or older. After two or three days it will be necessary to bait the area of the egg-deposit again, for hoppers hatching some time after the first application of bait. Under more or less moist conditions the bait should, however, continue to be effective for several days.

Hoppers that are on the point of moulting (shedding their skin) will not feed on the bait. It has, however, been found that they take it very readily immediately after the moult. Therefore a very good time to bait a band of hoppers is when, say, 80 per cent. of the hoppers have just moulted. They will then tend to stay on the baited area and a very good kill be obtained.

Hoppers in the 1st, 2nd and 3rd stages of development are more readily killed by means of bait than older hoppers. The older hoppers are more restless, and very active, and they are inclined to trek off the baited area quickly. It is, therefore, essential to locate all egg-deposits, and to kill the hoppers as soon as possible after hatching.

Results.—If hoppers will take the bait well they will show signs of diarrhoea approximately two to four hours afterwards on a warm day. Usually they do not trek very far from the feeding place and they die, in most instances, a couple of yards from the spot. Usually 24 hours approximately a quarter to half of the swarm should be dead or dying, and after 48 hours approximately nine-tenths should have been destroyed. If after three days a substantial number of the hoppers are left and are healthy, *i.e.*, showing no signs of diarrhoea, they should be baited again. The poison in the bait works slowly and one should not expect all the hoppers to die within an hour or so.

Dangers.—If bait is used according to these instructions no harm will be done to domestic animals or plants. If lumps and heaps of bait are left lying on the veld, domestic animals will pick up the bait and get poisoned.

Care should be taken, therefore:—

(1) that no lumps are left in the bait;

(2) that the bait is spread thinly and that no lumps or heaps are left which can be picked up by livestock;

(3) that the baited area is inspected and that all lumps and heaps are picked up; and

(4) that animals are not allowed to consume moist or dry bait while in bags or tins or while spread out to dry.

Acknowledgments.—Most of the above is quoted almost directly from Circular No. 26, Union Department of Agriculture and Forestry, Nov., 1936.

Small Earthen Storage Dams.

By the Irrigation Division.

II. DESIGN AND CONSTRUCTION.

Design of Embankment.—The embankment will naturally be formed from the soils available at the site, and if these are mainly of a sandy nature it is necessary to have a central hearting of clay or clayey soil to render the embankment reasonably watertight.

In addition to prevent free drainage under the base of the dam it is necessary to excavate a trench down to impervious formation along the centre line of the dam, and for this trench to be filled with puddled clay in order that it may act as an efficient cut off of sub-soil drainage.

This trench is generally described as the puddle or core trench.

If the impervious formation is rock it is necessary to construct a concrete core wall 18 inches thick and 3 feet in height along the centre line of the core trench, the remainder of the trench being filled with clay in the ordinary way, the object of this concrete core being merely to prevent creep of water along the junction of the clay and the rock. See fig. 4.

If good clay or clayey soil is available in unlimited quantity, such as black vlei soil, the type of construction is as shown in figure 3. If only a limited amount of clay is available the type of construction is as shown in fig. 4, except that the concrete cut off wall will not be required unless, as stated above, rock (which does not mean loose boulders) is encountered in the core trench.

If no clay or selected impervious soil is available and the material for the embankment is of a sandy nature with rock foundations, it is necessary to construct a central concrete core carried up through the embankment to full supply level.

The necessity for such a concrete core would, however, render the structure an expensive one, and the non-existence of clay or other suitable material would normally cause the site to be condemned.

The classes of materials to be used and their respective positions in the embankments are shown in figures 3 and 4. Certain of the more common materials have been classified as a guide to making the best use of the various soils that may be found at or near the site.

1. **Puddled Clay Core** (Core filling BELOW ground level).

General.—The function of this material is to form an impervious wall to intercept the sub-soil drainage beneath the dam. The best material is a good fat greasy clay entirely free from pebbles, stones, grass roots or any form of vegetable matter, and containing only a small proportion of gritty material.

Suitable Material in order of merit:—

(*a*) Black pot clay.
(*b*) Blue pot clay (dolorite origin).
(*c*) Red clay (diorite origin).
(*d*) White clay (granite origin).

If none of the above are available,

(*e*) Ordinary good antheap.

2. **Puddle Clay Core** (Core filling ABOVE ground level).

General.—Its action is similar to the above in that it forms the impervious wall through the centre of the embankment and is continuous with the core filling below ground level. The only difference is that in this case the filling above ground level must be able to resist cracking or drying out which will occur when the dam becomes empty, and the clay used should therefore contain a greater proportion of gritty material.

Suitable Material in order of merit:—

(*a*) The various types of heavy clays mentioned above. Black, blue, red or white, mixed with a sandy soil in the proportions, by volume, of 3 clay to 1 sand, giving a similar texture to clay required in brick making.

(*b*) Ordinary antheap.

(*c*) Decomposed clay schist.

(*d*) Decomposed granite clay.

3. **Hearting of Heavy Clay Soil** (Figure 3 only).

General.—This central hearting is merely a different type of "core wall above ground level"; the additional thickness of material off-setting the omittance of "puddling."

Suitable Material in order of merit:—

(*a*) Black vlei soil free from vegetable matter mixed with a sandy soil in the proportions of 3 black to 1 sand (by volume).

(*b*) Red diorite clay loam.

(*c*) Decomposed schist.

(*d*) Yellow granite clay.

4. **Best Available Soil.**

General.—This soil should be as clayey as possible. Its action is to assist the narrow core wall to form an impermeable wall through the centre of the embankment.

Suitable Material:—

A good loamy soil of not too coarse a grain.

5. **Compactable Gritty Soil.**

General.—One of its main functions is to form a blanket over the core or hearting to prevent the latter from drying out. In addition it must be capable of binding well, but at the same time must not be liable to crack on drying out. It must also be capable of retaining a slope of 2 to 1 when saturated; that is, it will not slip when covered with water.

Suitable Material in order of merit:—

(*a*) Red sandy loam (diorite series).
(*b*) Ordinary yellow and grey granite sub soils.
(*c*) Ordinary good sandveld soil.
(*d*) A mixture of 1 part pure clay and 3 parts sand (not river sand).

6. **Coarse Material.**

General.—This forms a protection to the central hearting. The principal feature required is that it shall be capable of good drainage; that is, it shall consist of a gravel with sufficient earthy material to enable it to bind together. The type of material required for road surfacing is a good example of the texture required.

Suitable Material in order of merit:—

(*a*) Red diorite rubble with a fair proportion of soil.
(*b*) Decomposed granite with a small proportion of clay.
(*c*) Coarse sandy soil.
(*d*) Gravel containing soil (not water washed pebbles).

For dams up to a full supply depth of 15 feet the following dimensions are recommended for the section of the embankment:—

Width on crest 6 feet, upstream slope 2 horizontal to 1 vertical, downstream slope 1½ horizontal to 1 vertical.

For dams with full supply depth of between 15 and 20 feet the above dimensions will apply, except that the upstream slope should be flattened to 2½ horizontal to 1 vertical.

For dams with full supply depths in excess of 20 feet it is recommended that the advice of an engineer should be obtained, as a specific design will be required.

In all cases the crest level of the dam will be at least 5 feet above the full supply level.

The upstream face of the dam should be protected from wave action by a 6 inch layer of rubble known as the "casing" of the dam. In the case of dams having a greater full supply depth than 15 feet it is advisable to lay dry stone pitching on top of the casing material as a further protection against wave action.

If the spillway channel is immediately adjacent to one flank of the dam it is essential that a training wall should be constructed at right angles to the centre line of the dam on this flank for a sufficient distance to ensure that the flood water from the spillway will enter the stream bed at least 20 feet below the toe of the embankment. Two training walls may be required if there are two spillways. This training wall is constructed to a height of 5 feet above spillway level at any point and the face of the wall along the spillway channel must be faced with grouted pitching.

In order to prevent the downstream toe of the embankment being undermined by flood water it is necessary to construct a dry stone toe across the stream bed channel, the top of this toe being at least up to bank level of the stream.

These essential features of an earthen dam where we have the case of an ordinary puddle core trench and a central hearting of clayey material are shown in fig. No. 3.

In figure No. 4 is shown the case where it is necessary, owing to rock foundations, to construct a concrete key wall in addition to the clay core and where, owing to the nature of the material, it is necessary to carry the clay core up to full supply level.

Setting Out Base of Embankment.—Before proceeding with the construction it is necessary to peg out the base of the dam, as its bottom width will vary with the height.

If the length of the dam at its crest level is not great, this pegging out can be done by stretching two wires or lengths of strong cord across the valley at the level intended for the top of the dam and at a distance apart equal to the crest width of the dam which, as previously stated, is 6 feet for dams up to 20 feet in height.

A measuring pole marked in feet and inches held vertically alongside the wire or cord will enable the height of the proposed bank above ground level at various points to be ascertained and from this the width of the base at each point.

For example, if the height at a certain point is 12 feet and the upstream slope is 2 horizontal to 1 vertical and the downstream slope is $1\frac{1}{2}$ horizontal to 1 vertical, then the

upstream toe of the dam will be 24 feet from the foot of the measuring pole, measured at right angles to the dam. Similarly the downstream toe will be 18 feet from the foot of the pole held vertically below the downstream wire. The total width of the base at this point will be 24+6+18, *i.e.*, 48 feet.

Figures 5a and 5b set out in detail this method of pegging out the toe lines.

The whole base of the dam can be determined in this way and demarcated by pegs being driven in at various points on the upstream and downstream toes. (See figure 6 first stage.)

Clearing Base of Dam.—Before any material is placed it is essential that the whole base of the dam should be ploughed over and the surface layers containing grass roots and vegetable matter removed by means of dam scoops or hand labour in order to obtain a firm solid base for the embankment.

The usual depth of such clearing may vary from 6 to 12 inches, dependent on the site. The material thus removed is not suitable for use in any portion of the embankment.

In addition, if any rock or boulders are exposed in the base of the dam above ground level they must be removed, by blasting if necessary, and any holes that are thus formed should be filled with well tamped selected soil.

Tree roots and stumps should also be removed to a depth of at least 2 feet below the cleared ground surface and the holes similarly refilled with well tamped selected soil.

The whole base, when cleared, should be roughened by harrowing and watered immediately before the first layer of material is placed in order to ensure a good bond between the soil and the placed material.

Core Trench and Core Wall.—The core or puddle trench should then be excavated down to impervious foundations or to a suitable depth in compact soil along the centre line of the dam and extend from full supply level on one bank to full supply level on the other bank.

If impervious foundations are not encountered at a shallower depth it may be stated, as a general rule, that the

trench should be excavated in compact soil to a depth of at least one-half the full supply depth at the point under consideration.

The width of the core trench at cleared ground level must be equal to the depth of the trench, the minimum depth at any point being 4 feet. The bottom of the trench must always be 4 feet wide.

The bed of the trench should be excavated on a varying slope with no vertical steps or drops. The material used for filling should be the best clay obtainable within a reasonable distance of the site and should be free from vegetable, slushy matter or an undue proportion of grit.

In the case of heavy clay such as is obtained from black vleis it is advisable that the material should be spread out and allowed to weather for some time before it is placed in the trench. If sufficient clay is not available a mixture of antheap and clay will make a suitable impervious filling for the core trench.

If rock foundations are exposed in the core trench a central concrete key wall 18 inches thick and 3 feet in height should be constructed of 1 : 3 : 6 concrete; the coarse aggregate for the concrete being well graded broken stone which will pass through a 3 inch mesh.

The sides and bottom of the trench should be wetted before filling, but any water standing in the trench should be pumped or drained out before any clay is placed.

The filling of the trench should be carried out by placing the weathered clay in horizontal layers not more than 3 inches in thickness, all clods should be thoroughly broken up and each layer of the material slightly moistened and well rammed or stamped in position so that it will form a uniform plastic mass.

Each layer should be picked over and moistened before the next layer is placed and the whole filling to ground level carried out as rapidly as possible.

If a clay hearting is required in the embankment it is necessary that the filling of the core trench should be extended

at least one foot above ground level in order that a good bond should be ensured with the clay hearting.

This filling above ground level will be carried out after the material in the embankment has been placed and consolidated to a depth of one foot on either side of the core trench.

Whilst this placing of ordinary material is being effected, the surface of the clay in the core trench should be protected by sacking which should be kept wet in order to prevent cracking of the clay.

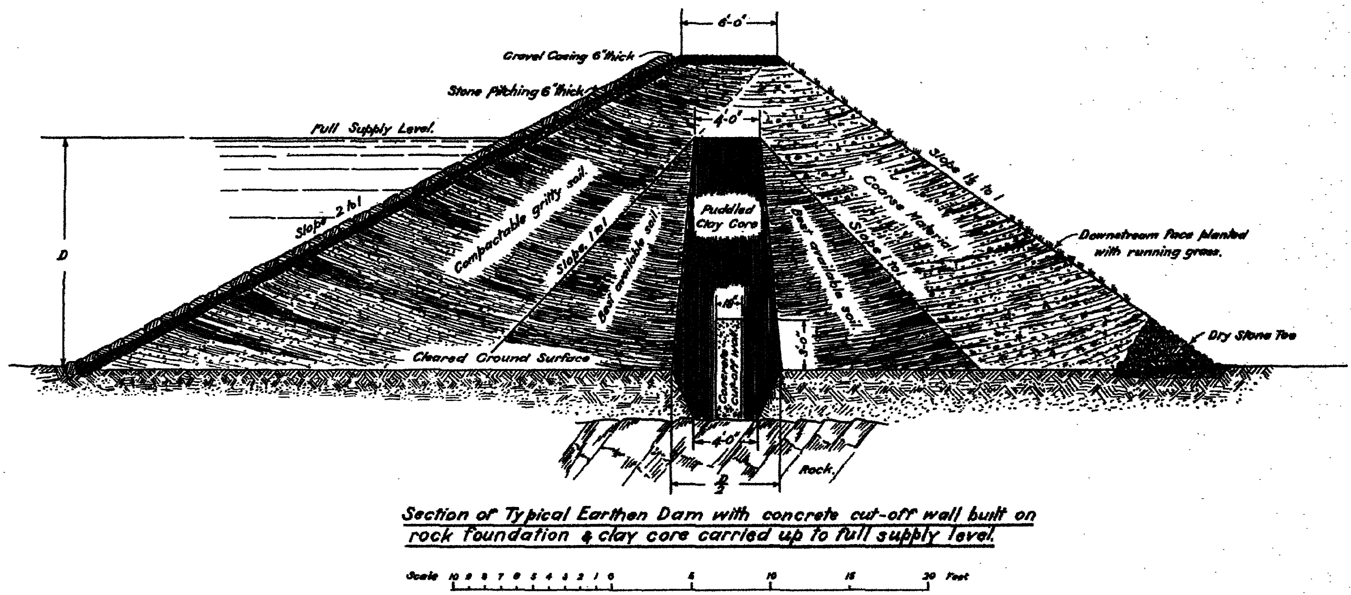
Similarly if the puddle core has to be extended through the embankment, the placing of the puddle core will be carried out in thin layers not more than 3 inches thick in the same way as the core trench and the filling will take place in stages after the material in the embankment has been consolidated to a depth of one foot above the old surface of the puddle core which has to be protected by sacking during the placing of the ordinary material.

The puddle core will be the width of the core trench at ground level and should be placed with its faces on a slight batter in the embankment itself and have a minimum width of 4 feet at full supply level. Details of the alternative designs of puddle core and clay hearting are shown in figures 3 and 4.

Drainage Downstream Section.—If suitable coarse material is not available for the downstream section of the embankment, and in any event on sections of the dam where the full supply level of the dam is greater than 20 feet in depth, it is necessary to provide drains below the section of the embankment downstream of the puddle core. These drains should be excavated to a depth of one foot below the cleared ground surface in the base of the dam and should be 18 inches in width.

They should have an even fall throughout of about 1 in 100 and be either led into a lateral open drain beyond the downstream toe of the embankment or led direct into the drystone toe.

The drains will be filled with well graded gravel or broken stone before material is placed on them. An arrangement of under drainage channels is shown dotted on the plan of the embankment in fig. No. 3.



Section of Typical Earthen Dam with concrete cut-off wall built on rock foundation & clay core carried up to full supply level.

Fig. 4.

Irrigation Division,
Salisbury
B.G.G. 14-12-37.

Laying of Outlet Pipe.—Every care should be exercised to prevent seepage of water along the surface of the outlet pipe, as if this occurs it would result in the failure of the dam by breaching, as the material in the embankment adjacent to the pipe would be eroded by the flowing water and the rate of flow gradually increased until a definite breach was formed in the embankment.

In addition, as the pipe cannot be got at after the embankment has been completed, it is therefore essential to prevent all seepage along the pipe. Thus concrete staunching rings must be placed at intervals along the length of the pipe and also the whole pipe encased with a covering of 4 inches of concrete, mixture 1 cement, 2 sand, 4 stone (maximum diameter 1 inch).

The trench for the outlet pipe should be excavated in natural formation beneath the base of the embankment at any convenient point such that the invert level is at a minimum of 12 inches above the bed of the stream.

Under no circumstances should the outlet pipe be carried through the embankment itself, as unequal settlement would cause leaks to develop in the pipe at the joints and the concrete cover itself to crack, with the inevitable possibility of the dam breaching.

The width and depth of the pipe trench will be determined by the size of the outlet pipe, as these dimensions should be sufficient to permit of about 4 inch cover of concrete all round the pipe.

For example, if the outlet pipe is 6 inches in diameter the depth and width of the trench should be 14 inches.

The diameter of the outlet pipe may vary from 2 inches if the dam is required for stock watering purposes up to 6 inches for the irrigation of land not exceeding 50 acres in extent.

It is usual to instal galvanised iron piping if the diameter is not in excess of 3 inches and cast iron piping if larger sizes are required, but in all cases the outlet piping should be supplied with flanged joints.

The concrete staunching rings will be installed at each flanged joint, and as these rings will be 18 inches thick and project 18 inches on all sides beyond the concrete cover, it is necessary to cut grooves or recesses 18 inches wide and 18 inches deep in the sides and bottom of the outlet pipe trench at the points where the flanged joints will be installed.

A flanged joint should also be installed at the centre of the core trench which will similarly be covered with a concrete staunching ring which will be extended downwards as a concrete supporting pillar to hard, sound formation at the bottom of the core trench.

As the piping is usually supplied in random lengths it is necessary to have the piping on the spot before the outlet pipe trench is excavated in order that the correct location of the staunching rings can be fixed.

The outlet pipe should be laid in position, covered with concrete, and the concrete pillar in the core trench constructed before the filling of the core trench is proceeded with.

A section of the embankment at the outlet pipe and details of the concerte cover and staunching rings are shown in fig. No. 3. The concrete around the pipe and in the staunching rings should be 1:2:4 concrete with the coarse aggregate of well graded broken stone which will pass through a 1 inch mesh.

If the outlet pipe has been well protected with concrete the outlet valve can be placed on the downstream side of the dam and thus obviate the expense of valve operating gear which would be involved if the valve were placed in the normal position on the upstream side.

In the case of low dams where the crest is under 15 feet in height it is possible to dispense with an outlet pipe under the embankment, as the water can be drawn out by means of a syphon over the embankment.

Drystone Toe.—The toe of the embankment on the downstream face of the dam across the stream channel section shall be formed of packed dry stone carried up to at least the top of stream bank level with the inner face of the toe at right angles to the slope of the embankment.

The material shall consist of sound boulders having minimum dimensions of 9 inches by 4 inches by 4 inches, and they shall be hand-packed in rough courses which have a general fall towards the centre line of the dam.

Smaller stones shall be driven home in the larger interstices between the boulders and rubble or gravel run in so that the whole shall form a stable mass not liable to slip.

Construction of Embankment.—Before starting the earthwork filling it is advisable to fix a few batter planks in permanent positions on each slope of the embankment as a guide to keeping a uniform and correct profile.

It is not necessary to carry the planks at once to the full height of the work, as they can be advanced as the earth filling proceeds.

By stretching a line behind the inside edges of any two batter planks the correct batter at any point on the slope can be obtained, and by this means the slope will be kept uniform.

The earthwork for the filling of the embankment can be most conveniently and cheaply transported to the site by means of dam scrapers hauled by mules, donkeys, or oxen if the material is close at hand. If, however, this material has to be hauled for some distance it is necessary to use Scotch carts, wagons or wheelbarrows.

In the case of wheelbarrows the pneumatic tyre type should be purchased, as although they are more expensive in capital cost, their use will result in much more economical handling of the material than with the ordinary type of barrow.

The use of dam scrapers has the further added advantage that good consolidation of the embankment is automatically ensured by the animals hauling these implements, frequently traversing over the material already placed, thus tramping it down and causing it to bind.

If dam scrapers are not utilised it is essential that each layer of material after placing should be well consolidated by the use of a roller or by hand rammers.

In no case should the material be placed in mounds. Each load when deposited should be spread out to form a layer not exceeding 6 inches in thickness. All clods should be broken up and the whole layer damped and well rammed down either by means of a roller or by hand rammers.

Each layer should be completed across the whole embankment before the next layer is placed, and anything in the nature of vertical junctions of earthwork should be avoided.

The top of the embankment should, at any time while material is being placed, have a dished appearance with the surface of the layers sloping inwards towards the centre line at a slope of about 1 in 10 and also having a slight slope from each flank towards the centre, and anything in the nature of horizontal stratification of the material should be avoided.

Before each layer is placed the ground or former layer of material with which it will be in contact should be roughened and wetted so that a good bond with the new material is ensured.

In addition the material during placing and spreading should be watered to keep it in a slightly moist condition.

In spite of the embankment having been well consolidated by wetting, rolling and tramping it is inevitable that settlement will occur after it has been finally completed.

In a well consolidated embankment such final settlement may be one-twentieth of its height and in an ordinary dam as constructed on a farm it is therefore advisable to allow one inch per foot of height for final settlement, *i.e.*, if the dam in the centre is 20 feet in height place the material to a height of 21 feet 8 inches, and where it is 12 feet in height at the sides place to a height of 13 feet and so on. The two methods of allowing for this settlement are shown in detail in fig. 5c.

The crest of the dam immediately after completion should therefore have the appearance of an arch with the highest portion of the arch at the deepest section of the dam.

The material for the embankment should not be excavated in close proximity to the toes of the finished work, and it is

usual to specify that no pits should be dug on either side of the embankment within a distance equal to the height of the finished bank.

Spillway.—A certain amount of excavation will usually be necessary in the spillway channel, and as the material will probably be suitable for use in the downstream section of the embankment, the spillway channel should be excavated whilst the embankment is under construction.

The spillway channel should be excavated to a uniform level over the width necessitated by the catchment area of the dam and the channel should have a fall of 1 in 100 away from the spillway crest or concrete sill on both the upstream and downstream sides of the centre line of the dam.

As it is essential that there should be no restriction in the spillway channel upstream of the dam all material at or above the level of the spillway crest upstream of the dam should be excavated within the arc of a circle whose radius is equal to the width of the spillway and whose centre is at the end of the spillway crest adjacent to the flank of the dam.

When the spillway is excavated in relatively soft material as is unfortunately so often the case in this country, it is necessary to construct a masonry or concrete sill wall across the spillway channel along the extension of the centre line of the dam.

Such sill wall should be 18 inches wide and be carried down for a minimum depth of 2 feet below the crest of the spillway. For concrete the mixture will be 1 cement, 3 sand and 6 broken stone, and for masonry the mortar will be 1 cement, 3 sand, the proportions being by volume.

In addition, if the spillway channel is in sandy formation it will be necessary to prevent erosion and cutting back by the construction of a series of wire and stone bolster weirs across the spillway channel at intervals downstream of the main sill wall.

Training Wall.—The training wall along the embankment side of the spillway channel downstream of the centre line of

the dam will be constructed of the same material as is used for the downstream section of the main embankment and will have a uniform height of 5 feet.

The usual section for this training wall is a crest width of 4 feet with slopes of $1\frac{1}{2}$ horizontal to 1 vertical.

The wall should be constructed for a sufficient length downstream of the spillway crest to ensure that the flood water will only be able to enter the stream channel at a minimum distance of 20 feet below the drystone toe of the dam. In many cases, however, it is cheaper to extend the training wall for a greater distance to some point where the flood water may be passed into the stream channel over hard formation which will not erode and necessitate additional protective pitching.

The sloping face of the training bank adjacent to the spillway channel, the nose of the embankment upstream of the spillway crest and the end of the training wall should be protected against scouring by grouted stone pitching, and instructions as to the laying of this pitching are given later.

Casing of Embankment.—In all cases the upstream face of the embankment should be protected by a 6 inch layer of coarse gravel or rubble, which shall be laid after the ordinary material in the embankment has been consolidated and trimmed off to the proper slope.

The casing material should consist of rubble or boulders whose maximum dimensions do not exceed 6 inches and the interstices filled with ordinary material.

If stone-pitching is to be laid on top of the casing the rubble should be able to pass through a 3 inch mesh and be mixed with sand to provide a well drained bedding for the pitching.

Drystone Pitching.—For dams which have a greater full supply depth than 15 feet it is necessary to protect the upstream face against erosion by wave action by laying dry stone pitching on top of the casing material.

Whenever practicable the pitching should not be laid until the embankment has had a good period in which to settle.

Pitching should consist of sound durable stone roughly hammer dressed so that they will meet all round their edges for a depth of at least one-quarter of their thickness and thus completely cover the embankment.

A large proportion of them should have a horizontal section at the base of not less than 40 square inches and the depth should be about 6 inches.

The stones should be laid with their broadest ends on the casing material and the whole shall be wedged and tightly packed together by single stones driven home into each large interstice between the tops of the stones and the remaining small interstices then completely filled with rubble or gravel.

A foundation course consisting of a line of headers shall be laid at the base of the pitching, the depth of this course to be a foot in excess of the pitching stones abutting on them.

Grouted Pitching.—The stone pitching along the spillway face of the training wall and round the nose of the embankment adjacent to the spillway channel shall be laid in the same way as the dry stone pitching, but the interstices between the stones shall only be filled with rubble and gravel to within 6 inches of the surface and the top 6 inches of the interstices shall be filled with well rammed concrete of 1:2:4 strength with a coarse aggregate of small sized stone which will all pass through a 1 inch mesh.

In fig. 6 an endeavour has been made to indicate pictorally the general scheme of construction in four different stages.

Cost.—The cost of the various items in the work will vary considerably in each individual case, and be dependent on the proximity of suitable material, types of implements used and the class and cost of labour employed, and in particular whether the services of a contractor are utilised for the construction.

Assuming, however, that the work is carried out by the farmer himself with an European supervisor, and that the

materials are in close proximity to the site, the following may be taken as generally indicating the probable costs of the various items of the work:—

Clearing of site	2d. per sq. yard
Excavation core trench in soil and gravel...	9d. per cu. yard
Clay core	1/6 per cu. yard
Concrete	35/- per cu. yard
Boulder excavation...	2/- per cu. yard
Rock excavation	5/- per cu. yard
Material in embankment	6d. per cu. yard
Dry stone toe	2/- per cu. yard
Dry stone pitching	1/- per sq. yard
Grouted pitching	2/6 per sq. yard
Casing material	9d. per cu. yard

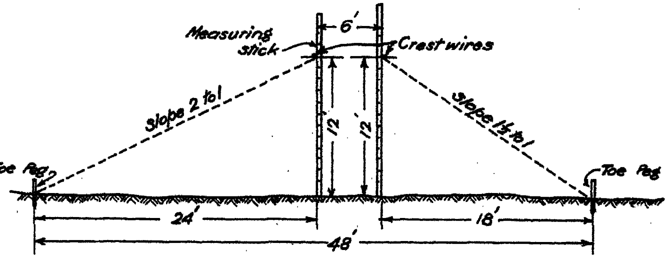


Fig. 5(a)

Showing how toe lines may be set out by measurements to obtain the correct slopes on embankment when the stream bed is practically horizontal.

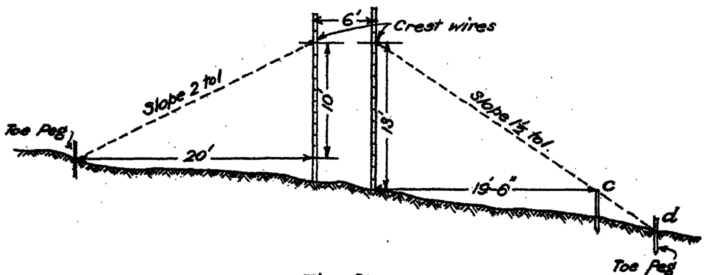


Fig. 5(b)

Showing how measurements for the toe lines should be made when level of stream bed varies. Note how the 1½ to 1 slope line must be carried through the point "C" to "d" which is on the true toe line.

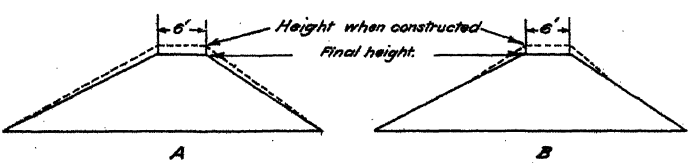


Fig 5(c)

ALLOWANCE FOR SETTLEMENT.

Diagram "A" shows the correct method of construction. The height of the wall is increased by an amount equal to 1" for each foot of final height by steepening the side slopes from the toes to the crest. Diagram "B" shows a cheaper method of adding this allowance which may safely be adopted on dams not exceeding 20' in height.

Southern Rhodesia Weather Bureau.

DECEMBER, 1937.

Pressure.—Barometric pressure was generally about normal.

Temperature.—Mean temperature was slightly below normal in the south and west, but slightly above normal in the north and east.

Weather Features.—The month opened with thunder conditions, but there was a vigorous invasion of cold southerly air on the 2nd and 3rd. A small mass of maritime air preceded the southerly air, and produced "guti" weather. There was a reversion to trade currents on the 4th, with an accompaniment of light scattered showers. The first general influx of Equatorial air occurred on the 7th, but was displaced again on the 8th and 9th by maritime air. Rain was general on the 7th and 8th and continued in the north, but clearing occurred in the south.

Equatorial air again took command on the 12th and continued until the 22nd. The dewpoints were, however, not very high and rain was patchy after the 14th, being mostly of the thunderstorm type.

There was a weak movement of maritime air in the south on the 22nd which resulted in a slackening off of rain in the south, though there was a fair amount on the 25th. Cloudy weather continued after this date, but rain ceased for a few days. In the north rain was general from the 22nd to the 26th. A general clearing occurred on the 28th, associated with an upper south-easterly current. A few showers occurred again on the 29th and 30th, owing to the formation of a trough and a fresh inflow of maritime air, but generally fair weather was reported on the 31st.

Although the rains were so late in starting, a large number of stations had reached their seasonal average by the end of the month.

Rainfall.—The rainfall for the month was about one inch above the normal.

PRECIPITATION.

Station.	Inches.	Normal.	No. of days.
Beitbridge...	1.87	2.27	11
Bindura	8.00	7.05	18
Bulawayo	5.70	5.07	14
Chipinga	6.58	7.92	16
Enkeldoorn	3.89	6.58	21
Fort Victoria	5.72	5.51	16
Gwaai Siding	4.56	5.23	16
Gwanda	4.11	4.24	12
Gwelo...	10.85	5.88	18
Hartley	9.21	6.68	19
Inyanga	10.63	7.49	21
Marandellas	12.31	7.31	18
Miami...	7.27	7.13	18
Mount Darwin	6.56	6.51	16
Mount Nuza...	17.83	15.55	24
Mtoko...	10.48	6.81	15
New Year's Gift	5.11	5.33	15
Nuanetsi	4.79	2.90	13
Plumtree	4.91	5.46	15
Que Que	7.13	6.17	15
Rusape...	10.37	7.04	17
Salisbury...	8.79	5.91	16
Shabani	4.65	4.65	16
Sinoia...	10.34	6.79	19
Sipolilo	5.12	7.11	17
Stapleford	15.31	12.32	25
Umtali...	6.59	5.46	19
Victoria Falls	7.12	6.01	15
Wankie	2.84	5.49	13

DECEMBER, 1937

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	Wet Bulb.	Dew Point	Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute Maximum : Date	Absolute Minimum : Date	Number of Days Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Beitbridge...	1,500	76.5	68.5	64	10.5	88.0	69.9	78.9	103 : 1st	62 : 3rd	20	...	27	...	78.4	962.7	881.5	...	6.8	...
Bindura...	3,700	71.0	64.9	61	8.2	80.5	64.8	72.7	90 : 1st	60 : 4th	7	1	11	...	71.3	891.9	...	...	6.5	...
Bulawayo	4,393	67.4	62.0	59	6.3	78.9	60.7	69.8	90 : 1st	54 : 4th	6	2	2	...	68.7	868.3	879.6	866.9	7.5	5.7
Chipinga	3,685	68.5	63.8	61	5.5	78.3	61.0	69.7	93 : 1st	51 : 3rd	4	3	2	...	68.4	891.6	881.0	...	5.7	...
Enkeldoorn...	4,788	67.3	62.1	59	5.7	77.5	59.6	68.5	90 : 1st	53 : 4th	2	2	...	...	66.7	856.6	880.0	...	6.2	...
Fort Victoria	3,571	70.7	64.2	60	7.7	80.7	62.8	71.7	96 : 1st	54 : 4th	5	2	7	...	70.5	894.1	880.0	...	7.0	...
Gwaai Siding	3,278	72.6	65.8	62	8.5	87.9	64.1	76.0	98 : 4th	52 : 10th	21	...	8	...	...	902.2	879.0	...	6.7	...
Gwanda...	3,233	70.8	64.1	60	7.8	82.5	64.1	73.3	98 : 1st	56 : 2nd	11	2	14	...	72.3	905.0	880.4	...	7.1	...
Gwelo	4,629	68.3	62.7	60	6.4	78.2	60.4	69.3	90 : 1st	54 : 3rd	2	2	...	...	67.8	861.2	879.7	...	6.9	...
Hartley...	3,879	72.0	64.2	60	9.6	82.7	63.4	73.1	93 : 1st	58 : 4th	9	...	4	...	71.4	884.0	879.5	...	6.2	...
Inyanga...	5,503	66.5	61.3	58	5.6	75.2	56.7	65.9	84 : 1st	48 : 4th	...	2	...	...	64.3	...	...	...	6.5	...
Marandellas	5,453	66.3	60.2	56	6.6	75.4	58.3	66.9	85 : 1st	54 : 3rd	...	1	...	...	65.4	...	...	...	4.2	...
Miami	4,090	69.6	64.2	61	6.5	79.0	62.3	70.7	89 : 7th	59 : 4th	4	1	1	...	69.9	877.4	879.4	...	4.4	...
Mount Darwin ...	3,179	72.7	66.7	64	8.4	81.9	65.5	73.7	92 : 1st	56 : 4th	7	1	17	...	72.9	906.3	...	...	6.9	...
Mount Nuza	6,668	58.0	56.3	55	1.6	64.1	52.5	58.3	78 : 1st	46 : 3rd	...	27	...	...	57.2	800.4	879.4	800.1	8.5	...
Mtoko	4,141	69.8	63.8	60	7.1	78.3	62.2	70.3	88 : 1st	55 : 4th	2	...	5	...	69.7	876.3	879.9	...	4.8	..
New Year's Gift...	2,690	72.7	67.2	64	6.9	83.3	63.9	73.6	98 : 1st	56 : 3rd	10	2	10	...	...	...	...	...	...	6.4
Nuanetsi	1,581	75.2	69.0	66	7.8	88.7	67.5	78.1	106 : 1st	59 : 4th	20	...	21	..	...	960.5	881.8	...	...	...
Plumtree	4,549	69.2	62.2	58	7.9	78.9	61.2	70.1	90 : 29th	55 : 3rd	4	1	2	...	69.3	863.0	879.1	...	6.0	...
Que Que...	3,999	70.5	63.9	60	7.6	81.9	63.1	72.5	95 : 1st	58 : 4th	8	...	3	...	71.1	880.5	879.7	...	5.8	...
Rusape	4,648	67.7	61.6	58	6.7	77.3	59.9	68.6	89 : 1st	52 : 4th	2	1	...	...	66.7	.	...	...	6.5	...
Salisbury	4,831	68.4	61.9	58	7.4	78.8	59.8	69.3	87 : 1st	54 : 4th	1	1	...	...	67.9	855.1	879.5	853.7	7.3	5.9
Shabani...	3,131	71.6	64.8	61	8.3	82.6	64.9	73.7	99 : 1st	56 : 3rd	10	2	17	...	72.7	...	...	...	7.8	...
Sinoia	3,795	72.0	65.4	62	7.8	82.5	63.8	73.1	90 : 1st	59 : 4th	9	...	6	...	71.8	886.9	879.8	...	5.8	...
Sipolilo	3,876	71.4	65.0	61	7.8	79.2	63.3	71.3	88 : 1st	57 : 4th	3	...	3	...	...	883.8	879.5	...	6.6	...
Stapleford	5,304	63.1	60.2	59	3.2	70.7	55.3	63.0	84 : 1st	41 : 4th	...	14	...	...	61.9	841.4	880.3	...	7.0	...
Umtali	3,672	70.3	64.7	62	6.9	81.7	62.1	71.9	97 : 1st	53 : 4th	5	1	...	...	70.0	891.8	880.8	890.4	6.7	5.4
Victoria Falls... ...	3,009	74.9	68.5	65	8.2	87.9	67.5	77.7	97 : 5th	64 : 4th	21	...	24	...	75.9	910.3	879.5	...	5.5	...
Wankie	2,567	77.7	69.4	65	10.7	91.0	70.3	80.7	99 : 29th	67 : 9th	24	...	31	...	78.9	924.9	879.4	...	6.4	...

Rainfall in December, 1937, in Hundredths of an Inch. Telegraphic Reports.

rea	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total	N r
1	13	...	...	5	14	29	16	16	...	...	...	20	17	23	106	79	...	9	69	50	2	3	10	25	25	...	...	...	...	12	...	543	
2	51	7	...	...	...	82	47	37	1	...	...	27	4	70	15	43	9	...	1	22	7	66	9	3	55	...	...	...	4	59	...	619	
3	44	27	...	...	...	11	37	22	28	...	...	17	15	105	...	3	39	...	7	11	59	101	20	...	24	3	68	...	1	127	...	769	
4	58	10	...	4	19	7	105	40	2	...	...	41	8	20	97	23	72	2	31	40	31	39	37	27	10	...	...	...	...	8	...	731	
5	17	6	...	7	2	31	27	93	...	...	2	37	25	8	79	44	...	...	64	...	1	15	...	...	2	...	...	..	27	9	...	496	
6	13	13	...	...	...	3	12	59	...	29	...	72	20	23	20	30	47	...	81	12	4	51	49	112	129	...	15	...	...	...	...	794	
7	1	3	...	...	13	1	56	81	27	28	...	110	33	66	13	26	38	38	65	50	41	36	10	85	73	25	4	...	4	2	...	929	
8	2	...	...	...	...	...	45	119	54	50	7	54	4	38	...	...	5	22	110	1	17	64	31	90	82	51	45	...	24	...	...	915	
9	6	...	...	...	...	...	73	97	27	29	20	22	35	96	5	...	71	5	89	30	26	14	18	78	68	34	41	1	12	...	..	897	
0	...	...	...	...	...	...	24	109	57	3	15	71	2	204	...	...	33	...	46	3	37	15	5	51	104	28	45	...	...	...	...	852	
ean	19	5	...	2	6	22	41	64	11	12	4	45	19	50	47	35	28	7	59	26	15	30	17	44	52	10	12	...	8	14	...	704	

Southern Rhodesia Veterinary Report.

NOVEMBER, 1937.

DISEASES.

Foot and Mouth Disease.—There was a slight extension of the disease in the Mutema Reserve, Melsetter district.

African Coast Fever.—The disease was diagnosed on the farm Kenilworth in the Melsetter native district.

Anthrax.—An outbreak occurred at Shangwa's kraal in the Mshagashi Native Purchase Area in the Chilimanzi native district. Mortality 5 head. All in contacts have been inoculated.

TUBERCULEIN TEST.

Nine bulls and 11 heifers were tested upon importation with negative results.

MALLEIN TEST.

Twenty-nine horses and 38 mules were tested. No reactions.

IMPORTATIONS.

From the Union of South Africa.—Horses 29, mules 38, sheep 993, bulls 9, cows 11.

From the Bechuanaland Protectorate.—Sheep 666.

EXPORTATIONS.

To the Union of South Africa.—Oxen 606, cows 13.

To Northern Rhodesia.—Oxen 48, cows 8, bulls 2, horses 2.

To Portuguese East Africa.—Oxen 37, cows 7, bulls 2.

EXPORTATIONS—MISCELLANEOUS.

To the United Kingdom in Cold Storage.—Chilled beef quarters, 5,560; frozen boned beef quarters, 3,280; kidneys, 236 lbs.; tongues, 4,641 lbs.; livers, 8,552 lbs.; hearts, 983 lbs.; tails, 893 lbs.; skirts, 1,086 lbs.; shanks, 6,050 lbs.

To Northern Rhodesia in Cold Storage.—Beef, 159,653 lbs.; pork carcases, 75; veal carcases, 10.

Meat Products.—From Liebig's Factory: Corned beef, 259,616 lbs.; beef fat, 47,000 lbs.; tongues, 4,500 lbs.; rolled beef, 540 lbs.; premier jus, 24,109 lbs.; liver meal, 37,800 lbs.

G. C. Hooper Sharpe,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-37.

Monthly Report No. 61. December, 1937.

Reports of winged swarms of the Red Locust (*Nomadacris septemfasciata*, Serv.) have been received from the following districts during December, namely: Marandellas, Makoni, Mtoko, Hartley, Mrewa, Insiza, Belalima-Mangwe, Sebungwe, Chibi, Inyanga, Victoria, Darwin, Belingwe, Lomagundi, Gwelo, Ndanga, Mazoe and Gwanda. These districts include the greater part of the Colony, apart from the extreme west.

No definite trend of movement has been apparent.

Storks and kites are stated to have been attending the swarms in certain instances.

Towards the end of the month swarms in certain districts were developing breeding colouration and egg-laying was definitely reported in the districts of Lomagundi, Mazoe and Ndanga during the last week. The egg deposits to date are apparently localised and of limited extent, but it would appear that hoppers are likely to hatch out in the Colony in appreciably larger numbers than last year.

The Department is well provided with material for conducting a vigorous campaign if necessary.

RUPERT W. JACK,
Chief Entomologist.

Farming Calendar.

THE SEASONS IN SOUTHERN RHODESIA.

For all practical purposes the year may be divided into three seasons, viz., the cold season, the hot season and the rainy season.

The Cold Season.—This season commences sometime in May and extends into August. During this period three types of weather occur:—

1. Settled fine weather is the general rule. The days are sunny with a cool easterly breeze, the nights clear and calm, frosts occurring, particularly in valleys, vleis and sheltered places on gently sloping ground.
2. Spells of warmer weather, usually limited to a couple of days. Night temperatures are appreciably higher, and the days warm. Such a spell is almost invariably followed by a cold snap.
3. Cold snaps of varying severity and duration may be expected two or three times in a month. "Guti" weather affects large areas in the south and east of the country. Strong cold winds from S.E. combined with overcast skies, and in hilly parts intermittent drizzle, render conditions unpleasant for man and beast. The normal duration of a cold snap is two or three days, after which settled conditions are re-established. Longer cold snaps (7 to 10 days) have been experienced during recent years, but these are abnormal.

Apart from drizzle during "guti" weather, rain is rare but not unknown during these months.

The coldest time of the year is normally at the end of June or at the beginning of July, but some of the coldest days on record have been in the early part of August.

The Hot Season.—From about the middle of August there is a steady increase in temperature. Short cold snaps may occur up to the end of September; but the subsequent warming up is rapid. The hottest time of the year for most of the country is about the end of October, but in the driest districts temperature increases slightly during November and December.

During October cloudiness increases, and thunderstorms are to be expected, except in the north and west. The storms increase in number and intensity until the regular rains set in. These storms stimulate the growth of grass, but are rarely sufficient to enable crops to be planted, and the hot days in between detract from their value. Some years storms are very few in number. At this time of year evaporation is very high. Gusty winds, mainly from E. or N.E., are prevalent during the mornings, raising the dust and rendering conditions unpleasant.

The Rainy Season.—The first set-in rains usually occur during the last ten days of November, but may on occasions be as much as a fortnight early or late. The December rains are mostly of the thunderstorm type, often heavy, falling during the afternoon or night. There is a tendency for a spell of fair weather to occur after Christmas. The January and February rains are of a more general character, and occur at any time of the day. March rains are mainly in the form of afternoon thunderstorms, and normally there is a decrease in the amount of rain as the month progresses. April rainfall is of little account, except in very wet seasons, when a fair amount may be recorded. "Guti" weather occurs in the south and east at intervals during the rainy season, and is particularly prevalent during March and April. Fair weather usually follows "guti" weather.

HAIL is not of frequent occurrence.

LIGHTNING is often severe, and is responsible for stock losses.

DROUGHT PERIODS (10 days or more when less than 0.10 inches of rain falls on any day) may occur at any time during the season, more particularly in the south.

TEMPERATURE.—There is a marked fall in temperature when the rainy season begins, but the fluctuations during the whole rainy season are not marked unless long dry spells occur.

WIND is usually light, although heavy squalls occur with thunderstorms, sometimes causing damage to plants, trees and farm buildings.

SUNSHINE.—During set-in rains there is very little sunshine, but sunny mornings are associated with thundery weather. On the average fifty per cent. of possible sunshine is recorded during the wet months.

Further details regarding weather or climate in different parts of the country may be had on application to the Meteorological Office, Department of Agriculture.

FORESTRY.

JANUARY.

If the rains are seasonable, plant out evergreen trees, such as gums, cypress, pines, etc. Fill in all blanks as soon as they are noticed, and do not leave them until the following season. Planting should be done on a wet day or, failing that, on a dull day, or late in the afternoon. Great care should be taken to see that the trees are not planted out any deeper than they stood in the tins or beds.

FEBRUARY.

Tree planting operations should be carried out on dull showery days or late in the afternoon. Take care in setting out the plants, avoid bending the roots, and do not plant deeper than the plants were in the seed beds or trays.

MARCH.

Cultivation where necessary should be undertaken between the rows of trees planted out in previous months. If cultivation is carried out with the hoe, care should be taken not to pile earth round the base of the stems. New ground for next season's planting should be roughly broken up with the plough. Bulk plantings may be proceeded with during the month.

APRIL.

Cultivate the soil in the young plantations either by means of machines or hand labour. The cultivation will conserve moisture. Hoed out weed growth should be applied as a mulch round the base of each young tree. Be careful not to pile earth round the stems of the young trees. Covering the stems with earth even for an inch or two interferes with the sap circulation and invites attacks by termites.

Steps should be taken to prepare seed beds for the slower growing species, i.e., pines, cypresses and callitris, and seed of these species may be sown from now until the end of June for planting during the coming rainy season.

MAY.

Start pricking out seedlings into tins. Deciduous trees which are propagated by means of cuttings should be taken in hand. See that the fire lines are in order, and in the case of woods which have formed canopy, remove inflammable material below the edge trees.

JUNE.

Care should be taken by further ploughing of land or burning of grass that all fireguards round plantations are in good order and effective. Thinnings may be carried out where necessary. Cuttings may be taken and struck now of deciduous trees, such as the Carolina poplar. The pricking out of conifer seedlings into tins should be continued, and sowing of such seed for the coming planting season may be completed. A commencement may be made of preparation of land to be planted during the ensuing season, e.g., by stumping if necessary, and ploughing where practicable.

CROPS.

JANUARY.

Turn your compost heaps on a wet day. Plough under witchweed traps within two months from germination. If only one trap is being planted, plant this month. If not already sown, put in the ensilage and fodder crops at once, such as maize and legumes, Kherson and S.E.S. oats and other hay grass crops. Sow short season crops like haricot beans, linseed, buckwheat, peas, summer oats, gram and mung bean, and sunnhemp for hay. Plant out grasses and kudzu vine for pasture. Ridge potatoes and cultivate thoroughly. Main crop can still be planted. Quick growing green manuring crops, such as cowpeas, soya beans and sunnhemp, may still be sown this month. Earth up ground nuts so that a small amount of loose soil is thrown over the crowns of the plants. Cultivate all growing crops well, and thoroughly eradicate weeds. Overhaul all hay-making implements and ploughs and get in thorough repair in preparation for the haying and ploughing seasons. Endeavour to mow grass fields early for hay and litter, and to obtain second cutting for hay in April. Mow grass paddocks infested with annual weeds to prevent the weeds seeding. Prevent Mexican marigold and other noxious weeds seeding by hoeing or pulling out the plants by hand. Keep a sharp look-out for maize stalk borer. Cut off the tops of infested plants or treat them with a recognised chemical preparation. Watch the maize lands for witchweed. Prevent witchweed plants from seeding by cultivation and by hand-pulling the plants. Make as much manure as possible by placing sunnhemp, grass, and litter in cattle kraals, pig sties and stables. If there is stumping and clearing to be done, push on with it.

FEBRUARY.

Turn your compost heaps on a wet day. Cultivate, and keep on cultivating as weather permits, to destroy weeds. Continue to look out for stalk borer, and, if infection is discovered, deal with infested plants as advised in January notes. Watch witchweed and continue cultivating and hand-pulling it. Plough under witchweed trap crops within two months from germination. Where practised, maize can be under-planted with sweet potato vines after the last cultivation for the following season's requirements. Potatoes and ground nuts will probably need to be ridged again. Catch crops of quick maturing beans, such as tepary bean, also buckwheat, can still be sown. Keep down all noxious weeds. This work can be undertaken on wet days. Make veld grass hay whenever a few days of fine weather permit. Early mowings provide the best hay. Keep potatoes in a cool shed, well ventilated. Pick over any potatoes in storage and remove bad ones. Continue to make as much farm manure as possible.

MARCH.

Plough under witchweed traps in time. Watch oats for rust, and, if badly infested, cut crop for hay as soon as weather permits. Ridge late potatoes, and if weather is dry prevent ridges from cracking, to check tuber moth infestation. Finish ploughing under all green manure crops while the ground is still moist enough to promote rapid decomposition. Cut silage crops and ensile. Cut out barren maize plants and feed to stock or ensile. Cut Sudan grass for hay to permit of final late growth for autumn grazing. Reap any crops that are ready, and plough the stubbles **at once.** Watch for ground nuts making second growth; reap, and when sufficiently dry, place in cocks with nuts inwards and cover the top securely. Watch the weather for hay-making and take advantage of fine spells. Towards the end of the month hay-making should normally be in full swing. Continue to plough all lands in succession immediately the crops are reaped for them. Vleis and irrigable lands should now be ready, or in process of being prepared, for winter crops. Early sowings of winter oats, barley or rye for green forage can be made. Allow any potatoes lifted to dry before storing them, but do not leave too long in the sun. Destroy witchweed and other noxious weeds. Continue to make all the kraal manure possible by throwing grass and litter into kraals, yards, etc. Begin to select in the field maize plants for seed purposes, and mark them with slips of coloured cloth. Press on with the breaking up of any virgin land which may have been stumped or cleared earlier in the year. Place orders for grain bags without delay. Early in the month silage pits should be cleaned out or, where necessary, new pits dug.

APRIL.

Don't forget witchweed cultivation. If sufficiently mature, begin cutting and stooking early maize over a small acreage and plough up the ground whilst still damp between the rows of stooks. Early stooks must be small. Ride your manure and compost to the lands for spreading and ploughing under. If ripe, reap and husk early planted maize, and keep in a separate dump. Continue to make field selections of the best maize plants, and mark those required for seed with strips of coloured cloth. Lift any ground nuts and potatoes showing signs of making second growth. Make silage; cut maize for this when the ears are in the "dough" stage. Feed sweet potato vines to stock, reserving any new growth of vines for grazing in May. Plough in any green manure crops not already turned under. Plough fallowed land. Keep potatoes reserved for seed on racks in a cool place protected from frost, but well ventilated, and green them in subdued light. Pick over potatoes which may be lifted, and remove the bad and diseased ones. Winter cereal crops for grain can be sown towards the end of the month. Remember that good and deep ploughing to a depth of at least 7 to 8 inches is essential, and the basis of all successful arable farming. If the lands are not already ploughed so deep, increase the depth of ploughing about an inch a year until this depth, or even more, is reached. On lands which have been ploughed for a number of years at the same depth, use a grubber to stir up the sub-soil without lifting it to the surface. Too much attention cannot be paid to good tillage. It is usually good practice to follow the plough immediately with a harrow or other suitable implement to break down the clods before they bake hard. Continue breaking up new lands; the earlier this is done the more complete is the decomposition of the vegetable matter in the soil. When making hay or coarse legumes such as velvet and dolichos beans and cowpeas, be sure that the vines are dry before stacking. Handle the hay as little as possible to avoid loss of leaf. Lay in supplies of thatching grass for thatching and repairing roofs. The veld may be beginning to dry off. Consideration may be given to mowing or otherwise preparing fire lines as a preventive against veld fires.

MAY.

Witchweed may still require attention on the stooked lands. Continue to cut and stook maize as it matures; make the stooks small to assist drying and prevent increase of diplodia. Later in the season the stooks may be made larger. See that the stooks are secure and pick up plants lying on the ground. Continue to plough up land between stooks of maize. Give all maize harvested, whether husked or in the husk, a chance to dry out before riding to the dumps. Do not begin shelling if the ears are still damp. Do not use new grain bags for harvesting maize. Make the dumps of unhusked ears as small as possible; the smaller the dump the quicker the grain will dry out. Grain on the cobs dries extremely slowly, if at all, in dumps of large size. Do not mix unhusked ears from the stooks with dryer ears harvested later from the standing crop. Keep the dryer ears in a separate dump; shell, bag and stack such maize separately. When cutting maize for stooking, insist on the stalks being cut at ground level. The plough, in Rhodesia, will not bury roots with stalks 8 to 12 inches high. A long stubble of stalks makes clearing of the ground for ploughing very tedious and expensive. If not already harvested, ground nuts should be lifted before the first frosts damage the hay. Sow most winter cereals on wet vleis or under irrigation early this month. Feed your sweet potato vines to stock; if frosts occur the vines will be killed. Dig and feed tubers from end of month onwards. Towards end of month harvest cattle pumpkins and melons and handle carefully; avoid bruising to prevent rotting. Place pumpkins and melons in a dry situation in the open and in a single layer. Supply plenty of roughage to cattle pens, kraals and stables to increase the manure supply. Collect and cart manure to lands for spreading. Do not attempt to plough in dry grass or quantities of maize refuse. The plough will not turn it under and it will not rot before next planting season. Burn such refuse and make a good job of the ploughing. If the weather seems set fair, commence brickmaking. A small kiln of bricks always on hand is most useful. As labour permits, re-thatch buildings and outhouses in need of repair. Overhaul, grease and paint planters, drills and other implements not required again until next season, and store away under cover. Think about your fertiliser requirements for next season and place your orders. From now onwards the second ploughing of new land broken up earlier in the season should be pushed on with as opportunity offers.

JUNE.

Select seed from the very best of your own crops. It is always wise to keep more seed than you may need for planting. Do not shell and ride your maize to the railway unless it is fit for export or market. Provide ample dunnage for your maize stacked at the railway or on the farm. Use maize cobs; husks are almost useless for this purpose. Select pumpkin and melon seed from the best specimens. Support your agricultural show and make it a success by preparing and entering as many exhibits as you can. No one is more to blame for a poor show than the farmers themselves. Make a list of the seed requirements for next season, and where purchases must be made, place the orders early. Veld fires must be anticipated, and if not already attended to, the mowing or burning of fireguards, both boundary and internal, should be proceeded with.

STOCK.

JANUARY.

Cattle.—Put the bulls into the herd now to secure spring calves. The bulls should be in good condition at the commencement of the service season and their condition should be maintained while they are working. This season calves should be looking well by this time and care must be taken

not to over-milk the cows in consequence. Cows rearing calves should not be milked more than once a day. Bullocks which are being fattened on grass should receive a concentrate ration from now onwards; 4-5 lbs. maize meal daily should be sufficient.

During the months of December and January veld grazing is usually plentiful, and very little extra feed in the form of concentrates is required for dairy stock. It should be borne in mind, however, that heavy milking cows are unable to satisfy their requirements for milk production from veld grazing alone, and should receive a daily allowance of grain; the latter should be fed at the rate of 2 lbs. for every gallon of milk produced daily, *i.e.*, a cow producing three gallons of milk should receive 6 to 7 lbs. of concentrates. An excellent mixture for this purpose is one consisting of four parts maize meal and one part ground-nut cake.

During wet weather, the provision of a clean dry shelter for calves is essential; the latter should not be crowded together in a small, damp, badly ventilated pen or muddy kraal. When treated in this manner, a calf is very liable to contract various ailments such as scour, etc. Scour is entirely preventable, and is usually caused by over-feeding, or feeding from dirty pails, feed boxes, etc. Calves which contract scour should be isolated, the milk ration reduced, and they should be dosed with a few tablespoonfuls of castor oil.

Sheep.—Keep the sheep away from vleis. During this time of the year they are liable to suffer severely from internal parasites and dosing should be regular. If nodular worm is present dose twice at 30-day intervals with the new remedy.

FEBRUARY.

Cattle.—The recommendations for January apply equally to this month. Be careful that the condition of the bulls is maintained, especially in the case of well-bred animals. A bull in poor condition cannot be expected to sire a large number of calves. As far as practicable cut veld hay during this month. Usually the optimum relation of yield and composition occurs now. During this month, in addition to maize, some protein concentrate such as peanut cake or cotton-cake will generally be necessary in the dairy cow mixture to keep up a good milk flow. Increase the grain ration to bullocks which are being fattened on grass and add some protein concentrate to their feed to make good the deficiency of this nutrient in the grazing.

Calves may be given a few hours' exercise on bright, sunny days; young stock, however, should not be allowed to run and graze with the herd, and are best kept in a cool, airy pen opening on to a small shady paddock where they can obtain a little exercise.

A good quality of sweet hay and water should always be available for young calves.

Sheep.—Continue as recommended for January. Dose regularly at 21-day intervals for wireworm and bankrot worm with the nicotine and bluestone remedy. Start putting in green food for April and May.

MARCH.

Cattle.—Arrangements for winter feed should be pushed on. For a well balanced winter ration, in addition to good quality veld hay, a succulent feed such as maize silage, majordas or pumpkins and a legume hay such as velvet beans, cowpeas or dolichos beans are essential. The milk supply will begin to decrease. In the case of cows rearing calves it is often good policy in this month to cease milking cows and to allow the calves to get all the milk from now on. Slightly increase the amount of grain to the dairy cows and increase the proportion of protein concentrate in the dairy

cow mixture to make good the usual loss of feeding value in the grass. Bullocks fattening on grass will do better for a daily ration of some succulent feed such as green mealies or sweet potato tops, unless a supply of green grass is still available.

Calves which are under two months old should be kept in and allowed to nibble at well-got hay; at the same time a little dry mealie meal and monkey nut cake will do them good and teach them to eat concentrates. An ample supply of clean water should be provided in the calf run.

Sheep.—Ewes should now commence lambing. Run the big udder ewes with lambs separate. If the grass has gone off the ewes and lambs should have access to some green feed for an hour or two daily. Continue dosing as for February. If hookworm is present dose now and keep ewes and lambs especially away from vleis.

APRIL.

Cattle.—Where winter conditions are good, early spring calves may be weaned now, but a common practice is to allow them to run with their dams until the early rains. Where supplementary feed is available, April to June are probably the best months of the year for cows to calve in. These months also suit the dairy farmer. Dry off cows which will not pay for a grain ration during the winter. Bullocks for winter fattening should be penned from now on. Steers fat off the grass in April are easily and cheaply topped off.

The season of abundant green pasture is over, and the natural grazing, unless supplemented by some green food or succulent roughage, is not sufficient to maintain a full flow of milk. The most economical supplement to veld grazing at this time is maize silage or green maize, and this should be fed in liberal quantities to all milking cows and growing stock. A few pounds of concentrates in addition would also be of great benefit to the milking cows, which should not be compelled to subsist entirely on veld hay and silage.

Sheep.—See that ewes and lambs have sufficient feed and continue dosing for wireworms and bankrot worm.

MAY.

Cattle.—By the middle of this month dairy cattle will require more serious attention in the matter of feed. Grass should be cut for bedding, and both cows and calves, if the weather is too cold, should be well bedded down at night from now onwards, and cowsheds should be put in good repair. Attention should be given to the water supplies, and care taken that they are clean and sufficient.

Boggy sources of water supply are a frequent source of loss of cattle during the winter months. With adequate water supplies cattle can withstand considerable shortage of grazing. Weaners should be fed a good roughage ration—with or without a small allowance of grain, depending on circumstances—to keep them growing through the winter months.

Get in the bullocks for winter fattening.

Sheep.—Especially from now on the ewes and lambs should have adequate feed such as green oats and barley or bean hay and a little maize. This will ensure an adequate supply of milk and hence good thrifty lambs. Dose for nodular worm.

JUNE.

Cattle.—Cows with autumn calves should be kept in the more sheltered paddocks. A watchful eye should be kept on all watering places in order to prevent their being fouled or stopped up. Where winter calves are

required, the bulls should be kept out of the herd until the end of July at least, and, in the meantime, they should be well fed and cared for in order to fit them for their work. The three watchwords in the dairy herd should be feed, shelter and bedding from now onwards.

At this period of the year winter feeding of dairy stock should commence in real earnest. The milking cows should now be in fairly good condition, and in order to maintain a full flow of milk throughout the cold, dry months of winter, it is essential that liberal feeding be practised. As far as possible an attempt should be made to imitate summer conditions by feeding an abundance of succulent and palatable food. Maize silage, sweet potatoes, pumpkins, etc., are very useful for this purpose, but these feeds should be supplemented by dry roughage of good quality, preferably a legume hay, and a liberal allowance of mixed concentrates.

For dairy heifers, weaned calves, etc., there is possibly no better ration than one consisting of maize silage, legume hay and a small portion of mixed concentrates, and these feeds, if supplied in liberal quantities, should serve to keep the young stock in a thrifty, growing condition.

Sheep.—Continue to feed the ewes and lambs well. It is of considerable assistance against parasites. Dose again at three weekly intervals for wireworm and bankrot worm.

DAIRYING.

JANUARY.

Under the weather conditions which now obtain, cream should be despatched to the creamery at least three times a week. It is of the greatest importance that cream should be cooled immediately after separation, and should be kept cool while on the farm and whilst in transit to the railway station or siding. While the cream is being cooled, it should be frequently stirred, using a stirrer with a plunger attachment. Warm, freshly separated cream should not be mixed with old cream which has already been cooled. Cool the fresh cream first and then mix thoroughly with the old cream. Gassiness is a common defect in the cream received at the creameries at this time of the year, and is caused by gas-producing organisms with which the milk and cream are contaminated. These organisms abound in mud, manure, stagnant water, etc., and develop and multiply very rapidly at high temperatures. Any precautions therefore which may be taken to eliminate dirt, manure, etc., from the milk and to keep the cream cool will prevent the development of gassiness.

As the night temperatures are fairly high, cheese-makers should not attempt to use night's milk for cheese-making; morning's milk plus a starter will give the best results. Gouda cheese-making operations are not usually successful at this season of the year, owing to the poor quality of the milk and the prevalence of gassiness. This type of cheese is best manufactured during March and subsequent months.

FEBRUARY.

This is normally the flush season as far as dairy produce is concerned; dairy cattle are usually in good condition and cows of average capacity should be able to subsist and maintain a full flow of milk on veld grazing alone.

The cheese in the storeroom is apt to develop mould during wet weather. If the cheese is well made and pressed and has a smooth rind, this mould is merely superficial and will not penetrate into the body of the cheese. Rubbing the cheese with a cloth moistened with a weak solution

of formalin or permanganate of potash usually checks the development of mould. During these months care must be taken not to use over-acid milk for cheese-making, and great care should also be taken of the starter. If this latter shows any signs of gassiness or develops any disagreeable flavour or odour it should be discarded and replaced by a fresh, clean starter. The cheese storeroom must be kept dark and flies excluded.

MARCH.

This is usually the most favourable month of the year for dairy operations. Cooler nights are now in evidence, and there is usually little difficulty in maintaining a low temperature in the dairy and cheese-room. If elementary precautions are taken, all cream should be first grade, and first-class cheese should be made, as a gassy condition of the milk is rare. Dairy cows, unless they are very high producers, can go without extra rations, because the grass is now in seed and grazing is ample. The cheese storeroom is generally full of cheese, and care should be taken to turn the cheese regularly. The windows and doors should be opened at night and closed in the daytime. A little mould on the cheese will not affect its quality, but if the mould is excessive the cheese should be rubbed daily.

APRIL.

At this season of the year the milking kraal is generally far from clean owing to the excessive amount of mud or dust which has accumulated during the latter part of the rainy season, and in consequence farmers invariably have trouble in producing first-grade cream. Every endeavour should be made to erect a small milking shed in which four or five cows or more can be milked at a time, and every effort should be made to keep the cows clean. The udders should be wiped before milking with a clean, damp cloth, and the farmer should see that the natives' hands are washed with soap and clean water before and after each milking.

If butter is made, the cream and washing water should be put out overnight, and if the cream is churned early the following morning, very little difficulty should be experienced in obtaining a good grain and a firm body in the butter.

From this time of the year onwards, cheese making operations are usually most successful. The evening's milk should not be kept in the dairy, but should be placed outside and covered over with butter muslin, cheese cloth or mosquito gauze netting. Care should always be exercised, however, in using evening's milk. Morning's milk plus a starter usually gives the best quality, and if a starter is used, care should be taken that it shows no signs of gasiness or off flavours.

MAY-JUNE.

At this time of the year the farmer should experience very little difficulty in producing cream of first-grade quality. During the winter months the separator should be adjusted so as to deliver cream testing 40 per cent. butter fat.

On exceptionally cold days care should be taken that the milk is not allowed to become too cold before separation—for efficient skimming, the milk should be separated immediately after milking and at a temperature not lower than 90 degrees F.

Farmers engaged in butter-making are usually successful in obtaining a good grain and firm body in butter at this season of the year. During cold weather it is frequently necessary to warm the cream for churning. The most satisfactory method of warming the cream to the proper churning temperature is to place the bucket or receptacle containing the cream in a tub or bath of water at a temperature of about 95 degrees F., stir the cream frequently and replace the water when cold.

Under the cool conditions which obtain from this time of the year onwards, cheese-making operations are usually most successful.

Care should always be exercised, however, in using evening's milk. If the milk is over-acid it should not be used, or a hard, dry cheese will result. Morning's milk plus a starter usually gives the best quality of cheese. The starter should have a clean sour taste and smell. In early winter, milk for cheese-making frequently contains a high percentage of fat, and in order to firm the curd properly in the whey it is usually necessary to raise the scalding temperature a few degrees.

VETERINARY.

JANUARY-MAY.

Tick life will be very active and in consequence tick-borne disease in evidence, especially redwater and gallsickness, and in districts where the bont tick prevails heartwater in cattle and sheep must be expected. Regular dipping to destroy tick life and minimise losses from disease should be conscientiously carried out. Horse sickness may be expected during these months and until the first frosts appear, usually about June. Blue tongue in sheep will be prevalent in uninoculated sheep. The inoculation of sheep against this disease should not be undertaken in the wet season unless animals can be kept under cover for 21 days following inoculation, and on account of possible abortion resulting, ewes in lamb should not be inoculated. Screw worm may be prevalent.

JUNE-SEPTEMBER.

After the first frost danger of horse sickness should disappear and blue tongue in sheep should be very little in evidence, sheep should be inoculated against this disease. Although cases of redwater and gallsickness occur all the year round, these diseases should not be prevalent. Scab in sheep and goats is a winter poverty disease and may be in evidence. Vegetable poisoning may be in evidence towards the end of August, especially on burnt veldt and with the first appearance of young green shoots.

OCTOBER-DECEMBER.

The first rains may be expected during this period and due to heat and moisture tick life will become active and cases of redwater and gall-sickness and other tick-borne diseases may be expected. Occasional horse-sickness may occur during December. Vegetable poisoning may still be in evidence unless grazing becomes good.

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Agricultural Journal

Edited by the Director of Agriculture.

(Assisted by the Staff of the Agricultural Department).

PUBLISHED MONTHLY.

Subscription: 5/- per annum; payable to the Accountant, Department of Agriculture, Salisbury.

VOL. XXXV.] MARCH, 1938. [No. 3

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, *Salisbury.*

Spacing Maize.—The following letter was received from Capt. J. M. Moubray, Chipoli, Shamva:—

"In order to see if witchweed could be more easily controlled I planted one land of maize this season with the rows six feet apart and the grains nine inches from each other in the rows. This method gives the same stand per acre as with three foot rows and the plants eighteen inches apart. Whether wide planting is better in a wet year I cannot say, but in the six foot rows the plants seem more vigorous and the cobs larger than in the three foot rows. The wide spacing has shown me that a native will cover more ground per day in ground so planted than with narrower rows. Supervision is easier and the chances of leaving growing witchweed behind are less. Burtt-

Davy does not go into yields where the spacing is as wide as 6 feet and there seems to be little data on the effect of sunlight on crop yield. When I recently returned from a short holiday I asked one of my natives how the maize looked on a certain field, and he replied, 'Master, the mealies are so big that when you walk through them in the day time it is dark.' It is quite obvious that in such a stand only a certain proportion of the foliage can be exposed to the sunlight. In the early part of the season a single section of a spring tooth harrow can be worked in maize spaced at six feet, and many farmers consider this the most efficient weeder. Perhaps, Sir, you can give some very good reasons why six foot spacing is not more generally used, as my results so far point to no diminution in yield. As shown by washouts the feeder roots completely fill the space between the rows. So far this season witchweed infestation is much lighter here than last year."

Reply by the Division of Agriculture.—The practice of spacing maize at 6 feet by 9 inches on land infested with witchweed has been recommended by this Department for several years, since it enables hand labour on the control of witchweed to be greatly economised by the use of a section of a spring-tooth harrow between the rows. Mr. G. P. Ingram, of Concession, has used this system of planting and cultivation with great success for several years past, making one stroke of the harrow close against one row of maize, and on the return journey working the harrow close against the other row. In this way he has found that very little of the parasite is left (in the rows of maize) to be removed by hand.

As Capt. Moubray points out, a further advantage of this system of planting is that supervision of the work of controlling witchweed is also rendered much easier, and also its destruction by hoeing, instead of harrowing, where this is necessary owing to continuous wet weather, or the blowing down of much of the maize.

Five series of experiments were carried out by this Department on the Salisbury Experiment Station during the four seasons 1930-31 to 1933-34 to investigate the effect of (1)

wide-spacing of maize on the yield of grain per acre, and (2) the sowing of bean hay crops between the rows, with the following results:—

Yields of Maize in Bags per Acre.

Distance of spacing.	No. of plants per acre.	Season 1933-34.	Season 1932-33.	Season 1931-32. Series 1.	Season 1931-32. Series 2.	Season 1930-31.	Average 4 seasons (18 plots).
3 ft. x 18 ins.	9,680	22.14	16.61	24.53	22.50	14.79	20.11
6 ft. x 9 ins.	9,680	22.48	16.55	24.35	23.75	12.88	20.00
9 ft. x 6 ins.	9,680	19.03	16.00	21.95	18.53	11.24	17.35
9 ft. x 9 ins.	6.453	17.75	15.50	19.45	17.96	11.28	16.39
9 ft. x 9 ins.	†Beans	17.18	15.59	18.56	17.25	10.67	15.86

The seasons 1930-31 and 1932-33 were unfavourable, and the three other seasons were favourable.

These results show that although there was little or no difference in yield between the standard spacing of 3 ft. x 18 ins. and the somewhat wide spacing of 6 ft. x 9 ins., there was a decrease of 13 to 18 per cent. when the space between the rows was widened to 9 feet. A further reduction in yield took place as a result of the space between the plants in the widely-spaced rows being increased to 9 inches instead of 6 inches, and the competition caused by the sowing of cow-peas and soya beans between the rows of maize after the last cultivation at the end of January was responsible for a further decrease in the yield of maize. In this case the maize yielded under 80 per cent. of the yield obtained from the normal spacing. The amount of dry fodder produced by the bean crop was very small, averaging only half a ton per acre. The collection of the hay from between the rows of maize would require a larger expenditure for labour than the harvesting of a normal crop from the open land, and it is doubtful therefore whether the small crop of hay obtained by the former method would compensate for the loss in yield of maize, and the cost of seed and labour involved in its production. It is also obvious that the growing of another crop between the maize where witchweed infests the soil will handicap the maize unduly, and also render it much more difficult to destroy the parasite.

As a means of economising hand labour and of reducing the cost of witchweed eradication, spacing maize at 6 feet by 9 inches and the use of a section of a spring-tooth harrow are to be strongly recommended.

Another means of economising hand labour, which has been recommended for many years by this Department, is the use of single oxen, mules, and donkeys for inter-row cultivation, after the use of two oxen abreast becomes impossible. As far as is known Capt. Moubray is the only gentleman who has put this into practice. He has used donkeys for this purpose for a number of years, and it is believed that all his inter-row cultivation is done by donkeys.

Pastures for Pigs.—Although young pigs will not grow rapidly if given only bulky foods—such as pasture—because of the limited capacity of their digestive tract, approximately one-third of their diet may consist of good pasture. In the case of dry sows, four-fifths of the diet may be provided as pasture.

Pasture, being relatively cheap fodder, should be used to the greatest economic capacity in pig feeding. Not only does grazing provide pigs with cheap food, but it provides a measure of insurance against deficiencies of minerals and vitamins which are likely to occur when pigs are intensively housed and hand-fed.

Pigs require a relatively high proportion of protein in their food, and they are unable to cope with large amounts of fibre; it is, therefore, desirable to graze pigs on pasture or forage crops when they are young and succulent.

Annual forage crops have the advantage of yielding large quantities of green feed in a short time; also, the practice of ploughing and planting pig paddocks twice a year is a satisfactory method of providing sanitation and control of parasites in the piggery. However, some permanent pasture is usually desirable in the piggery, but it should be stocked lightly and given frequent rests to preserve the stand and to prevent fouling of the paddock.

Wherever it can be grown, lucerne provides the best permanent pasture for pigs, but to prevent the pigs from rooting

and spoiling the lucerne plants their snouts should be either cut or ringed. When lucerne cannot be used Kikuyu grass is a very good substitute. Kikuyu has the advantage of being able to withstand severe grazing and rooting, and will quickly recover from drastic treatment by the pigs. It is a palatable and nutritious grass, and will thrive under a wide range of climatic and soil conditions.—(*Queensland Agricultural Journal.*)

Wintersome and Legume Silage.—The following enquiry and reply are published for general information:—

"We have read with much interest an article which appeared on page 1439 in the issue of *The Farmers' Weekly* dated 2nd February, under the heading "Ensiling Legumes with Wintersome," dealing with experiments carried out by your Department, and shall be much obliged if you will let us have details of same."

Reply:—"In reply to your letter of the 7th instant, I beg to submit the following report by Mr. H. C. Arnold, Manager of the Salisbury Experiment Station, on the results of Wintersome and legume silage.

It is hardly possible to supply full details of all of our molasses and Wintersome silage trials, and the details required are not clearly stated. The following are supplied, trusting they will meet the case—

"Somerset" velvet beans produce heavier crops than any of the other legumes which can be grown under summer rainfall conditions, and is therefore our most valuable source of protein. Wintersome belongs to the kaffir corn family, and although its fodder is low in protein the sugary juice contained in the stalks makes it particularly palatable to the cattle.

At the time these experiments were commenced molasses was too expensive to use for silage making in this Colony, and it was suggested that Wintersome fodder could be used instead.

Trials in which velvet bean fodder was ensiled, both with and without molasses, were made one season, and these showed

that although the velvet bean cured quite well by itself it was not palatable to the cattle. The addition of molasses had the effect of increasing its palatability. In the following season a mixture containing one-half velvet bean fodder and one-half of Wintersome fodder was ensiled, and in another pit velvet bean fodder was again ensiled by itself. Representative samples were prepared of each kind of material for chemical analysis. A part of each sample was taken for analysis in fresh condition, and the other part of each of the samples was enclosed in a net and ensiled in the middle of the bulk of the corresponding material.

The silage was made about the middle of April from crops which were sown at the end of the preceding November.

The silos were opened five months after the material was put into them, and it was fed over a period of several days. The samples for chemical analysis were re-covered and duly analysed by the Chemical Branch of this Department. This analysis indicated that there had not been appreciable loss of protein from the velvet been when it was ensiled by itself, but when it was fed to the cattle they did not eat it readily. Nevertheless, they ate it well enough when it was mixed with other fodder and meal, to derive full benefit from it. The material which consisted of Wintersome and velvet bean mixed, had a molasses scent and was very readily eaten by the cattle without the addition of other food or spice of any kind. The analysis of the velvet bean fodder, after separating it from the Wintersome fodder with which it had been ensiled, showed that it contained 0.5 per cent. less protein than the fresh material.

In the tabulation below is shown the protein content calculated on 100 per cent. of dry matter of (*a*) molasses treated velvet bean fodder and (*b*) Wintersome treated velvet bean fodder, both before and after the ensiling process.

Protein Content of Velvet Bean Fodder and Silage.

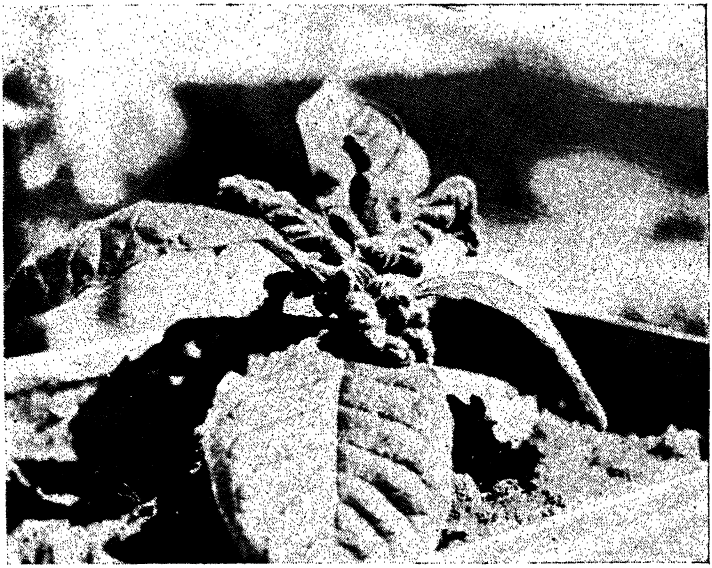
	Fresh Fodder.	Cured Fodder (Silage).
(*a*) Molasses treated	12.9%	10.7%
(*b*) Wintersome treated	14.6%	14.1%

These results indicate that there was a much smaller loss of protein during the curing process when Wintersome fodder was used than there was in the molasses-treated material. It is safe to assume therefore that when Wintersome fodder is well mixed with velvet bean in the proportion of 50-50 it is as effective as molasses in reducing the loss of protein which may take place during the curing process, and it is also as useful for increasing the palatability of the legume. It may be pointed out that in order to secure these results the Wintersome fodder should not be either too young or too old; from four to five months old is the best time. The basic principles for making molasses silage should also be adhered to.

Experiments at Matopos (unpublished) showed that a mixture of two-thirds velvet bean fodder and one-third Wintersome fodder were satisfactory.''

The Milk Problem in Europe.—It is interesting to note the conclusion arrived at by five experts who studied the conditions found in Great Britain, Norway, Sweden, Denmark, Holland and Switzerland, and published recently in the Bulletin of the Health Department. The nutritional, hygenic, economic and social aspects within these countries have been studied in considerable detail, and the conclusions and recommendations number 36 points. They report that too little attention is being devoted to the proper feeding of dairy cows. For human consumption milk ought to be both clean and safe. Veterinary supervision over production is advocated, and medical supervision over distribution. If pasteurisation were compulsory there is reason to believe that infection from milk would be completely prevented. Milk should be graded and the produce paid for on the basis of quality, but milk for liquid consumption should not be graded. Only the best milk available should be directed to the liquid market. There is reason to believe that if the cost of liquid milk could be appreciably lowered there would be a substantial increase in demand for it. It is believed that the future of of the Dairy Industry lies in the elimination of the small,

and concentration into the hands of the large distributors. The consumption of milk increases directly with the size of the income and inversely with the number in the family. So long as purchasing power is inadequate social measures are necessary. Of these the milk in schools scheme and the Oslo breakfast are specially commended. The effect of propaganda in increasing consumption is thought to be over-estimated. The best possible method is to ensure the provision of a supply of clean and safe milk.



1. Sucker growth from an affected plant cut down almost to ground level. Note stunting and puckering of young leaves, and the downward curling of leaf edges and tips.

2. Young affected plant in the field. Note sudden transition from normal leaves to the very small distorted leaves bunched in the centre.

A New and Serious Disease of Tobacco in S. Rhodesia.

PRELIMINARY NOTE.

By G. M. Wickens, Ph.D., D.I.C., Plant Pathologist, Tobacco Research Station, Trelawney.

During the season 1936-37 the writer's attention was drawn to a peculiar disease of tobacco that had broken out on one or two farms in the Umvukwes area. Recently information has come to hand that a late-planted 45-acre land on one of these farms gave a negligible yield as a result of this disease, and that further outbreaks have occurred this season on a number of farms in the same district. Towards the end of last season one plant showing symptoms of the disease was found on the Station.

During the current season the writer has seen the disease on a farm in the Trelawney area, where in the centre of a large field some four to five hundred young plants were affected. The disease is also present here on the Station in almost every land, but is restricted to a few small patches and has not done any serious damage.

In the season 1936-37 it was not possible to do more than carry out a few simple preliminary experiments, which established that the disease could not be mechanically transmitted by handling. With improved facilities and the occurrence of the disease here on the Station fairly early in the current season, the writer has been able to study the disease both experimentally and by detailed field observations.

From the results of this work so far obtained it is evident that the disease may under certain conditions spread rapidly through fields of tobacco and cause very serious losses. The

object of this preliminary note is to acquaint growers with the nature of this disease, in the hope that all those who have seen it in their lands will communicate with the writer so that the extent of its distribution through the Colony may be accurately gauged.

Symptoms.—The symptoms of this disease in the field are somewhat variable, and it is not proposed in this note to give a detailed technical description of the full symptom expression. It will suffice to describe briefly the most obvious of the abnormalities.

The most striking symptoms, which are clearly brought out in the accompanying photographs, are severe stunting of the main stem and violent distortion of the young leaves. The nature of the leaf distortion can best be pictured by imagining the leaf blade to be a piece of material and the midribs and veins to be puckering threads run through it.

When plants become infected at a comparatively young stage there occurs an almost complete cessation of growth of the main stem, and the transition from healthy to severely distorted leaves is rather sudden. This gives the plants the appearance of a rosette, with healthy leaves spread out horizontally all round and the very small distorted younger leaves forming in the centre a tightly bunched knot.

Quite commonly affected plants do not adopt this rosette habit, or if they do may later grow out of it somewhat. In such cases the main stem, although making some growth, still remains rather stunted, and the leaves, although not so severely puckered as those in the centres of the rosettes, are still small and distorted. A characteristic feature of the leaf distortion in such partially recovering or less severely affected plants is the sharp curling under of the leaf blades at the tips. Often, in plants that become infected somewhat later in life, the plant is more severely affected on one side than the other, and this, owing to growth of the main stem being checked more on one side than the other, causes the flower head to be bent over, sometimes so much that it points downwards to the ground.

Nature of the Disease and Means of Transmission.—Although it is not possible at present to be quite certain, all the experimental evidence so far obtained points to this being a virus disease transmitted by the aphid *Myzus persicae*, the common tobacco greenfly. Further experiments carried out this year confirm the fact that the disease is not mechanically transmissible by handling.

Preliminary Suggestions for Control.—Plants that become infected early in life have never been observed to recover sufficiently to be of any commercial value, and prompt roguing and destruction of such plants is obviously desirable. If it be finally established that greenfly are the agents by which the disease is spread from plant to plant, it will be necessary also to take steps to control this insect.

By the time this article is published reaping will at least be well on the way, and no measures taken now will appreciably affect the current season's crop, except perhaps on very late planted lands. But it is highly probable that the disease is carried over the winter in some natural host other than tobacco, and the roguing and destruction of every affected plant, at least as soon as every reapable leaf is removed, will lessen the chances of survival over the dry season. It is perhaps hardly necessary to add that the presence in the Colony of this new disease makes the early removal of stalks from the land after reaping is finished, and immediate destruction of volunteer plants discovered during the dry season—measures that have proved so successful in the control of the whitefly-transmitted leaf curl—all the more essential.

Concluding Notes.—This disease, which is quite distinct from the well known whitefly-transmitted leaf curl, is new to the Colony. It has points in common with the Rotterdam B disease that occurs in the Dutch East Indies, and with Kromnek, but seems to be distinct from these also. As far as the writer has been able so far to discover from the literature available, the disease is not only new to Rhodesia but, at least in so far as it affects tobacco, new to science. It is, therefore, as regards the chances of its causing widespread damage, at

present rather an unknown quantity. Reports from growers who have seen this disease in their fields would be of great assistance, for if such reports show that during the present season it has been widely distributed over the Colony and has caused appreciable damage in affected fields, it will be essential that much time be devoted to further study. In particular, information as to when the disease was first seen, the extent of its spread, the variety affected, and the occurrence of greenfly, would be useful. In case there be any doubt as to the identity of the disease seen in the fields with that described here, the writer would be glad to receive specimens for examination.

FARM ROADS.

By STUART CHANDLER, Chief Road Engineer.

The large increased use of motor transport by farmers has made road construction on farms a more vital need than in the past. It is now well recognised that it pays to make good roads even on farms as, in the end, they save time, money and soil and reduce the upkeep of vehicles, whether motor vehicles or animal-drawn.

No hard and fast specification can be laid down for the construction of farm roads, as these must of necessity be built to suit individual needs but, as a general practice, an ordinary farm road need not be more than 15 feet in width and, in most cases, a suitable graded dirt road will meet all needs.

The first thing to be done, of course, is to select the best alignment. This, as far as possible, should be kept on the highest ground, as by so doing it avoids any large catchment of water which has otherwise to be disposed of, but it is realised that this is not always possible as, owing to existing lands, the road can only be placed on the ground that is left available. However, assuming that the line of road has been selected, it is first necessary to take out all stumps and vegetation for a width of 20 feet. The 15 feet road should then be kept on the lower side of this 20 feet and should be made by excavating to a depth of 6 inches on each side of the 15 feet and cambering this up for a width of 3 feet on each side, the spoil thus obtained should then be thrown into the centre of the road and raked over smoothly. This then should give, when settled, the correct camber; one that will enable vehicles to keep on the road in either dry or wet weather unless the soil is of a red clay, which becomes very slippery when wet. This difficulty could be overcome by either mixing a layer of sand with the top surface or by placing on about 2 inches of gravel.

At every 100 yard, more or less, intervals, mitre drains should be cut on a down slope and at an angle of about 45 degrees from the line of road for the purpose of taking away

any water lying alongside the road. On the top side these drains should be led into the catchwater drain and on the bottom side should be led into the veld. The angle quoted must not be rigidly adhered to, as it must be varied according to the slope, especially on the lower side, where the angle should be such as to allow of the flow of water being just sufficient to clear the road without causing erosion.

In places where the ground is liable to be boggy, it is necessary for the road to be gravelled and hard. A layer of 6 inches of gravel should be placed on the road, preferably in two layers of 3 inches each, the first layer to be consolidated by traffic before the second one is superimposed. This gravel should be laid with a camber of about 1 in 24. There need be no special foundations put in prior to the laying of gravel, as it will be found that if large stones are placed at the bottom they will either sink in the mud or come through to the surface, whereas a layer of gravel, well consolidated and forming a mat, will sink in but very little.

When the gravel is laid, it should be dumped at least two yards in front of where it is to be settled so that each shovel full that is thrown on the road is put on separately. If it is dumped immediately in front of the road being made and then merely levelled off, it will be found that the finished road will be bumpy, due to the fact that the bottom portion of the dump settles hard and that pushed off the dump to be levelled out still remains unconsolidated.

The most important matter on any road, whether built of dirt or gravel, is that of drainage. Catchwater drains must be built on the top side of the road on the remaining 5 feet. They should be placed about 5 feet away from the edge of the road. These drains, of course, must vary in size according to the amount of catchment area above them, but an average size can be taken as 2 feet wide and 9 inches deep. It is not advisable to have the drains deeper than necessary. It is far better to have them wider to carry the water, as by this means there is not so much danger of soil erosion.

Invert drains must be placed across the road at the lowest points. These invert drains should be constructed 45 feet wide, that is 15 feet flat in the bottom and 15 feet on each slope. The drains should be about 12 inches deep and, to

make a lasting job, they should be stone pitched throughout. The stones of the pitching should be placed on edge and, as far as possible, should be placed at right angles to the traffic, but this is not absolutely necessary. The invert drain should have a fall of about 9 inches in the 15 feet width. This will allow the water to flow through without scouring and without depositing silt. These drains can be made by merely putting a layer of gravel, but they are not so effective as when they are stone pitched, as it will be found that after a heavy rain the gravel will nearly always scour out into a narrow channel at the bottom.

In constructing a road across a vlei, the most difficult matter is that of drainage, as vleis are usually so flat that it is not an easy matter to get the water away. In this case the road should first be built up to a height of one foot with ground excavated from the drains and from the side cut of the road and afterwards a layer of gravel 6 inches deep placed on the top. There should be a catchwater drain on each side of the road and inverts should be placed at fairly frequent intervals.

Where a farm road join a main road, the greatest care should be taken to see that all bush is cut down on the side of the road so as to give a clear view of on-coming traffic and the farm road should be splayed off at each corner so as to make the 15 feet width into a 30 feet width where it joins the main road. It is advisable, if possible, that the farm road should meet the main road at right angles.

The road work does not cease after the road has been made. It is most essential that regular maintenance should be given to it. This consists chiefly in raking over any ruts that have been caused by heavy traffic, which will avoid the water running down the centre of the road in keeping the sides of the road clear of grass to allow the water a clear run-off, and by seeing that the catchwater and other drains are kept clear of growth and silt. If this is not done, the work put in in the construction will soon be wasted.

If any farmer is in doubt as to the methods of carrying out this work, the Roads Department will always be willing to give any possible advice on the subject and all enquiries will be dealt with as promptly as possible.

Effect of Age on the Nutritive Value of Kikuyu Grass.

By A. J. TAYLOR, Union of South Africa Department of Agriculture Press Service.

The well-known saying of Dean Swift in praise of the man who makes two blades of grass grow where only one grew before, contains an underlying truth which is not fully appreciated by those who quote the saying, and, perhaps, it was not appreciated by the famous Dean himself.

It should be noted that he referred to "blades" of grass, not to grass in general. Are we then to reckon Dean Swift among the pioneers of modern grassland ideas? Modern pasture management aims particularly at encouraging the growth of the blade or leaf of the plant rather than a general increase in yield or herbage. Research has shown that the feeding value of the leaf is much greater than that of the stem of grass, particularly when the leafage is young and growing vigorously.

Numerous samples of kikuyu grass at various stages of growth have been analysed at Cedara, and the results of a few of these analyses are given in order to indicate the differences between leaf and stem and between young vigorously growing grass and more mature herbage. A sample of old, withered grass is also included to indicate the deterioration of kikuyu under such conditions.

Differences between Leaf and Stem.—Kikuyu (clippings), crude protein 24.5 per cent., crude fibre 20.0 per cent., total ash 10.2 per cent., soluble ash 8.9 per cent., lime 0.40 per cent., phosphoric oxide 1.00 per cent. Kikuyu (12 to 20 inches long), leaf and stem respectively, crude protein 13.3 and 11.6 per cent., crude fibre 30.5 and 33.9 per cent., total

ash 7.6 and 7.6 per cent., soluble ash 6.2 and 6.1 per cent., lime 0.60 and 0.48 per cent., phosphoric oxide 0.45 and 0.44 per cent. Kikuyu (old withered), crude protein 5.2 per cent., crude fibre 31.7 per cent., total ash 7.1 per cent., soluble ash 3.6 per cent., lime 0.72 per cent., phosphoric oxide 0.21 per cent. Paspalum (18 to 24 inches long), leaf and stem respectively, crude protein 13.3 and 8.8 per cent., crude fibre 36.2 and 43.2 per cent., total ash 6.9 and 6.4 per cent., soluble ash 5.2 and 5.3 per cent., lime 0.66 and 0.32 per cent., phosphoric oxide 0.39 and 0.37 per cent. Cocksfoot, leaf and stem respectively, crude protein 12.2 and 8.3 per cent., crude fibre 26.4 and 35.5 per cent., total ash 9.8 and 7.3 per cent., soluble ash 5.4 and 4.1 per cent.

The "clippings" represent leaf growth in a very young stage, the material eaten by stock on properly-managed, well-manured, regularly-grazed kikuyu pastures.

The samples which were separated into "leaf" and "stem" were obtained from demonstration plots which were not grazed and carried grass which was more mature, the length ranging from 12 to 24 inches.

The first point to be noted is that this older material is much inferior in composition and feeding value to correctly managed pasture grass collected from the grazing camps, since the protein, ash and phosphoric oxide percentages are little more than half those found in the case of young "clippings," whilst the fibre is 50 per cent. higher, even in the "leaf." There is an increase in the lime content of the more mature grass, a phenomenon commonly noted in more mature herbage as compared with very young growth. The high figures quoted for the "clippings" are not exceptional, and are in good agreement with the results of numerous analyses of such pastures.

The stem is more fibrous than the leaf, and its protein content is lower; the ash figures show little difference, but the leaf is richer in the important minerals, *viz.*, lime and phosphorus. In this respect, kikuyu shows less difference between leaf and stem than do many other grasses. Data for *Paspalum*

dilatatum and for cocksfoot are also given in order to indicate the position in regard to these valuable pasture grasses.

It is plain, therefore, that in order to obtain the highest nutritive value from kikuyu or any pasture grass, the growth of the blade must be encouraged by maintaining the fertility of the soil at a high level, whilst the formation of the less valuable stem is controlled by frequent regular rotational grazing, so that the herbage is always kept in a young and rapidly growing condition.

Preparing Cattle for Show.

By The Animal Husbandry Division.

Reasons for Showing.—Probably the most important reason for showing cattle is to advertise the breeder and to sell breeding stock, especially bulls. Any stock shown should therefore be in such condition and so selected as to be an advertisement to the breeder and not call for explanations, as is sometimes the case, as to why the animals are so small or in such poor condition.

Choice of Stock.—The choice of stock for show must be made well in advance. The Show catalogue should be carefully studied before making a selection. Nothing is so disappointing as to find out at the last moment that certain animals are not eligible or cannot be shown in the classes desired.

Cows for exhibition should be selected if possible a year in advance. They should be bred to calve a few weeks before the Show. By this plan each cow should be at her best, with a large udder and have a few weeks in which to recover from freshening. This is particularly important with dairy cows.

With young bulls and heifers such long preparation is unnecessary. They should be selected so as to be as near the maximum age as possible for the class in which they are to be shown. Well grown animals generally have the advantage over smaller ones in the same class.

Feeding.—Animals should be shown in good flesh, not overfat, but smoothly covered and firm. Animals in poor condition should not be shown. Overfatness is dangerous and many valuable breeding animals have been spoilt as breeders by overfattening for Show.

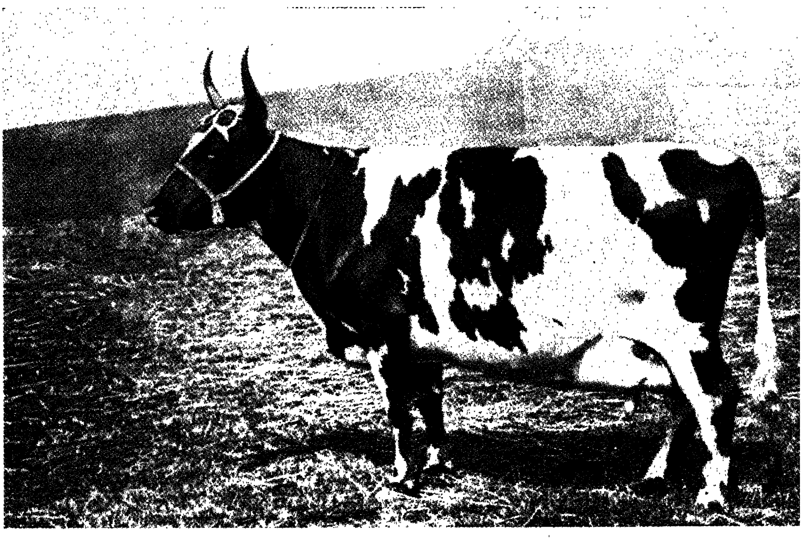
No particular system of feeding is necessary. The animals should receive good treatment using the rations available. The

quantities fed should be kept well within the limits of the appetite. Overheating feeds such as an excessive amount of maize should not be used, especially in hot weather. Linseed meal is particularly valuable in fitting animals to improve the handling qualities of the hide. Failing linseed meal, ground nut cake makes a good substitute. Bran is another valuable feed at this time on account of its laxative and cooling qualities. A useful concentrate ration for fitting cattle is maize meal 300 lbs., bran 100 lbs., ground nut cake 150 lbs. Ground sunflower head and seeds makes a fair substitute for bran. The quantity of roughage feeds such as silage, veld hay and pumpkins should be limited somewhat in the case of bulls in order to guard against the over-development of paunch.

Exercise.—The animals should get plenty of exercise. As far as bulls are concerned most of this exercise should be obtained by leading them. In the case of heifers and cows a good portion of the exercise should be obtained in the same way. It is only by training the animals to lead well and to stand squarely with the head held erect that a really good impression can be made in the Show Ring. Patience at this stage is well repaid later and much trouble should be taken to teach an animal to lead and to stand well. The correct stance should be got by patiently pushing the animal backward or forward or touching the misplaced foot gently.

Any cow, heifer, or young bull should be thoroughly halter-broken before it is taken into the ring and be accustomed to the usual handling given it by a judge. Old bulls should lead quietly on a stick.

Stabling.—The animals should, if possible, be stabled for a couple of months before showing. They should be washed and scrubbed with soap and water and the coats thoroughly rinsed. To secure the maximum suppleness of skin they should be lightly blanketed for the last six to eight weeks. They should then not be allowed to remain out of doors in the sun without blankets, except when being exercised. The blanket protects the animal from flies and improves the hair and skin. Linen or ordinary sacking make useful blanketing materials.



An Ayrshire cow well fitted and correctly posed.
(Taken from the Ayrshire Cattle Society's Journal.)

The animals should be groomed daily. Grooming improves the coat and promotes health. The brush used should not be hard and a curry comb should be used very sparingly except to remove dirt or manure. If the animal is well bedded at this stage much cleansing will be saved. As a final touch after each grooming the coat should be smoothed off with a cloth.

The animal should be washed periodically and during the last two weeks it can be washed to advantage every third or fourth day, as washing followed by blanketing aids greatly in producing a loose pliable skin. A good quality soap should be used. Persistent manure stains on white animals can be removed fairly effectively by plastering the stains thickly with a paste of finely ground charcoal and water which is brushed of thoroughly when dry. More than one application may be necessary. The hair should be clipped where necessary well in advance of the Show. The clipping required varies with the breed and quality of the hair and hide. In most breeds the hair round the face, withers, tail head, neck and tail, except the switch, is clipped. In dairy breeds the coarse hair on the udder is often clipped away, except the long hair on the milk veins, which should be left intact to emphasise the veins. Clipping a few weeks before the Show allows the hair to grow out somewhat and the coat looks softer.

Care of Horns and Feet.—If sufficient time is available the horn should be trained to grow out in the correct way for the breed. This is generally done by attaching cylindrical weights which screw on to the tops of the horns, where it is desired to bring the tips down, or by hanging a weight over a pulley over the beast's head, where it is necessary to "cock the horns up."

It is necessary to be gentle and gradual in this bending of the horns. The start should be made when the horns are young, and inexperienced breeders should consult a practical showman of the breed before starting to modify the horns. A month or two before the Show the horns should be smoothed with a rasp and then scraped lengthwise with a piece of glass until nearly smooth. They should then be finished off with

fine sandpaper or emery cloth. The horns should then be frequently polished with a mixture of powdered pumice stone and sweet oil until the time of the Show.

It is often difficult to trim the feet properly unless the animal has been trained to stand quietly or is thrown. For this reason the feet are often neglected. It is not uncommon to see a really good animal turned down for bad feet. The hoofs must be trimmed to be symmetrical. This can be done with a hoof knife, rasp, chisel and mallet. After trimming the hoof should be rasped smooth. After the final smoothing the hoof may be oiled and rubbed to a polish.

Transport to the Show and on the Show Ground.—The ration should remain the same at the Show Grounds as on the farm. Wherever possible arrangements should be made to send the home feeds with the animals.

It is a good plan to arrange for the animals to arrive at the Show Grounds at least two days before the Show so that they can settle down and the final preparation can be made with plenty of time in hand.

The night before showing the tails should be washed and blued if white. They should then be braided into three or four small braids and left overnight. When ready to show open up the plaits and brush out the tail, thus giving it an attractive fluffy appearance.

Just before showing the use of a *very little* sweet oil or a mixture of equal parts sweet oil and alcohol on the cloth with which the final smoothing of the coat is to be recommended with smooth coated breeds. In beef breeds and breeds with long coats the final conformation may often be improved by brushing up the hair in parts, just before entering the ring, with a damp brush or a curry comb so as to cover hollows or smooth the outline where desired.

If the cattle are not drinking freely they may be induced to take a full drink if given salt the night before.

When in the ring the animals should be handled to show them off to the best advantage and catch the eye of the judge. Any attendants leading the cattle should be dressed cleanly and neatly.

Soil Drainage and Utilisation of Vleis.

By R. H. Roberts, B.Sc.(Eng.), Assistant Irrigation Engineer.

The drainage of vlei lands has been frequently effected in the past by cutting a central channel on a steep slope. While this practice is cheap and very effective in the initial years, it merely results in additional trouble before long, as the channel becomes a "donga" and a great deal of expense is involved in controlling it to avoid the total loss of the valuable soil brought under cultivation. Moreover, it is impossible to control the sub-drainage and re-constitute the vlei-conditions if it is desired to do so in years of low rainfall. It is not generally known, perhaps, that tampering with vleis which are definitely the sources of public streams is prohibited under the "Water Act of 1927."

For these reasons the drainage of vlei lands has never been strongly advocated by this Department, and it is only with the adoption of proper methods of drainage that the reclamation of wet land should be attempted.

There is no doubt that land exists on many farms which is extremely rich and capable of producing heavy yields per acre if it were once freed of its surplus moisture. Moreover, land of this type does not usually occur in large self-contained blocks; most frequently it is found in the form of patches or tongues mixed up with "dry" red soils, so that proper working of the whole area as one is very difficult. A common case, for instance, is that of a tongue of wet soil extending from the edge of an adjacent vlei. In passing, it may be observed that wet patches of this nature are often found to be extending and widening themselves as time goes on, so that it is possible that they are caused by the trampling action of cattle in the wet soil of the adjacent vlei. The extension in area of the wet land is also due to the higher ground being

maintained under cultivation, and thus absorbing more moisture, which gradually percolates down to the low-lying area.

Necessity for Drainage.—A soil consists of an aggregation of a very large number of small particles, which vary greatly in composition, size and shape. Since these particles do not fit snugly together, spaces exist between them, so much so that the volume of voids constitutes approximately 50 per cent. of the total. In a well drained soil each particle is coated with a film of moisture which clings to the particle by force of surface tension. The void spaces are therefore filled with air, which is a vital necessity for the maintenance of plant life. If an excess of moisture is forced on the soil it temporarily fills the voids, but proceeds to gravitate downwards and draws in a fresh supply of air behind it—that is if the soil is properly drained, naturally or artificially; if not, the surplus water merely stagnates and prevents the renewal of the oxygen supply.

A plentiful supply of free oxygen is as indispensable to plant life as to animal life. Oxygen is necessary for the germination of the seed, for the propagation of roots, for the soil bacteria which produce nitrogen in its various forms, and for many other processes and chemical changes essential to the fertility of the soil.

Here, then, is an urgent argument for good drainage.

Another effect of under-drainage is to encourage the crops to root themselves deeply. If the permanent ground water stands near the surface of the soil early in the season, the roots are compelled to confine themselves to the upper few inches. If a drought develops later in the season, the water surface falls and the shallow soil in which the roots are confined becomes dry, since capillary action is too slow in supplying the necessary moisture. With proper drainage the early roots are compelled to penetrate more deeply into the soil in search of moisture, so that supplies are more evenly drawn upon and the plant is in a much better position to withstand a dry spell. Moreover, the decay of these roots later leaves addition means of entry for air into the deeper parts of the soil.

Wet lands are "cold" lands, owing partly to the high specific heat of water, which demands a greater quantity of heat to warm it than does an equal weight of soil, and partly to the cooling effect of the high rate of evaporation from a wet surface. The effect of drainage, by lowering the level of the ground-water surface, is to raise the temperature of the soil, particularly in the upper 12 inches, and thereby greatly to improve the conditions for plant development.

The most obvious benefit of drainage is in preventing a heavy soil becoming unworkable through excessive moisture. When properly under-drained, the surplus water is quickly removed, so that the heavy soil may be ploughed and planted at the same time as the adjacent lighter soil.

Causes of Water-logging.—As far as Rhodesia is concerned, three main causes may be recognised:—

(1) Surface water running off from high ground and collecting upon adjacent low-lying flat lands, which are unable to pass it off or absorb it sufficiently rapidly.

(2) Seepage water percolating from the lower strata of high ground on to lower lying areas, and reaching the latter either directly on the surface or by rising from below.

(3) Lands in general which are underlaid at a shallow depth by heavy clay beds, forming an impervious sub-soil.

Since these causes do not always work singly, but more frequently combine to a greater or lesser degree, the diagnoses and cure of the trouble is not usually the simple matter it might appear. There is no doubt, however, that in a great many cases water-logging is to a large extent due to surface water from higher ground collecting and lying on the flat black lands below, and to that extent the treatment is obvious. A system of storm drains and contour ridges should be employed on the high ground to collect and divert the surplus water and prevent it reaching the low-lying lands.

Types of Drain.—The aim and object of all systems of under-drainage is to lower the level of the ground-water by providing it with outlets, properly proportioned as to depth and distance apart, so that surplus water will gravitate into them, and leave no more than a normal moisture content in

the upper layers of soil. The flow of ground-water is resisted by the particles of the soil through which it has to pass. The tighter the soil, the greater the resistance it offers, and the steeper the gradient of the surface of the ground-water. Obviously, the steeper the gradient, the closer must the drains be placed together, if the surface of the ground-water is not to lie at less than a given depth below the surface of the ground.

No hard-and-fast rules can be laid down as yet for Rhodesian conditions, but a general guide may be taken from practice overseas, where good drainage is generally secured in average loose loamy soil with drains 100 feet apart and 3½ feet deep. In heavier soils they would need to be correspondingly closer together, but not necessarily deeper.

Open Drains.—Open drains are the most obvious means of removing surplus water, and in certain circumstances they should and must be used. Apart from their use purely as storm water drains, there are often cases where water seeping down from porous strata of adjacent high ground on to the low-lying land can be intercepted by means of an open drain, which would give a cheap solution of the problem. Again, open drains are necessary to collect and dispose of water led into them by other systems of under-drains.

Open drains, however, suffer from several disadvantages: they are an unmitigated nuisance in ploughed lands and require a certain amount of attention for cleaning. Moreover, they are objectionable, in that they harbour weeds, are liable to damage by cattle, and are a potential means of soil erosion. Some form of covered drain is therefore always preferable for the arable land itself.

French Drains.—The earliest development of the open drain was to fill it in, after providing some device in the bottom of the trench through which the water could readily percolate. Numerous expedients have been adopted, ranging from bundles of brushwood to properly-built stone drains with paved bottoms, and top and sides built of flat stones or brick. Two slender poles are sometimes laid side by side and a third laid on top, the whole being covered with brushwood and soil. With the "white ant" problem in Rhodesia,

none of the timbered French drains are likely to prove very long-lived, and some type of stone drain is to be preferred if stone is reasonably available.

If a drain of this type is to prove a permanent asset, a fair amount of trouble should be taken to lay the stone as closely as possible to prevent fine material silting in and clogging the openings. Good broken brick often makes a substitute for stone. The coarser stone should be placed in the bottom, followed by smaller stone and then a layer of gravel, before refilling the trench. Bricks form a neat channel, but can only be recommended if thoroughly well burnt and carefully selected; the ordinary farm-made brick is not usually a sufficiently durable article. An under-drain like a chain, is only as strong as its weakest link; one soft brick is enough to clog the whole drain.

The depth of the drain should not be less than 3 feet, and very much better results will be obtained if the depth is made 3 ft. 6 ins. or 4 ft. However, where a definite subsoil of very tight clay exists, there is no point in going more than a foot into it, and the drains will require to be correspondingly closer together. For economy's sake, not only in the excavation but also in the stone filling, the width of the trench at the bottom should be as narrow as possible; twelve inches is ample, but the actual figure will be dictated by the size of the stone that is to be used.

The gradient of the trench will often be controlled by the type of lay-out adopted for the whole system, but should be as steep as possible, since a drain of this description offers a considerable amount of resistance to flow. The gradient should be as uniform as possible, and, while a change from a flat slope to a steeper one is permissible, the reverse should always be avoided, to prevent silt deposits clogging the channel.

The lay-out of a system of French drains depends so much on the peculiarities of each individual case that general rules are not of much value, particularly as, before undertaking such work, it is usually advisable to obtain proper engineering advice. Apart, however, from a whole system of drains, very good work can often be done with a single drain

to cure an isolated spot or tongue of wet land, in which case the drain is often placed to advantage on the upper side of the centre of the wet patch. Strips of wet land as wide as twenty yards can usually be effectively treated by a single French drain.

Tile Drains.—The invention and cheap manufacture of circular tiles revolutionised drainage practice. The water was provided with a uniform, clear channel, a great improvement on the tortuous passage afforded by a French drain. Very little fall was required to carry the water off (as little as 2 ins. in 100 ft.). If the work was carefully done and good material used, the drains were practically everlasting.

Tiles should not be less than 3 ins. in diameter, and are usually best laid at a depth of between 3 and 4 ft. Lesser depths are sometimes used, but in a country of cheap labour it is better economy to dig deeper trenches and space them somewhat further apart so as to reduce the amount of tiles required.

The cost of tiles is at present the chief drawback to their use under Rhodesian conditions.

The distance between the tile-drains will vary from 50 ft. or less in tight soils, up to 200 ft. in looser soils, and the actual disposition of the system of trenches will depend on the local conditions of shape, slope, position of natural channels, etc. The trenches require to be carefully dug to secure an absolutely uniform gradient, without bumps or hollows, which would cause clogging. Accurate levelling is therefore required both before and after the excavation of the trench.

The tiles should be laid as soon as the trench has been dug and smoothly graded. Great care should be taken in laying the tiles to ensure a close flat at the joints. It is essential for permanently satisfactory results that the tiles themselves should be perfectly circular in section, straight and with square ends, so that a minimum of adjustment will be necessary in fitting the tiles closely together. No appreciable space is required at the joints; water will percolate through the closest joint, and if too much space is left it will only result in silt gaining entry to the drain and clogging it up.

When the tiles have been properly laid and inspected, they should be covered with a few inches of soil (free from stones, which might break the tiles) to prevent movement, and then the mass of earth can be filled back into the trench, either by hand or by some form of scraper.

Where a minor tile drain joins a main line (usually of bigger diameter), it should enter above the centre of the main tile and at an angle of 30 degrees or so. A Y-piece is preferable to a T-piece. The joints at the junction should be made with wet clay. The outfall of a line of tile-drain into a natural channel requires special treatment, and should be walled off with brick or concrete to prevent damage by cattle. The additional precaution is often taken of covering the end with metal gauze to keep out rats and other vermin.

Generally speaking, tile draining, if properly carried out, is very efficient and gives permanent results, but cannot be recommended at present for Rhodesian conditions on account of the expense.

Mole-Draining.—Mole-draining is no new discovery, but it has gained prominence in recent years through improvements in the mole-draining plough and the application of mechanical power.

Mole-draining consists essentially of forming a series of miniature tunnels through the subsoil by means of a hardened steel "cartridge" or "torpedo," attached to the bottom of a sharp, strong, vertical coulter, which projects downwards from the framework of the plough, consisting of a skid (often on wheels).

The application of mole-draining is strictly limited to lands having clay sub-soils, for it is obvious that the tunnels will not be permanent in soils of a loose character. Mole-drains are best placed at a depth of 16 to 18 ins., which is sufficient to get them into firm subsoil and protect them from damage due to ploughing at ordinary depths. Modern practice appears to have crystallised in favour of a mole 2½ ins. in diameter. Greater permanence is given to the drain by attaching a hard steel ball or bottle expander to the rear of the cartridge; the expander enlarges the drain, leaving a hard polished surface, and closes up the slit left by the coulter.

The power required to pull the mole-plough is considerable, depending upon the depth and diameter of the moles and the nature of the soil. The draught may be greatly reduced if furrows are opened up with a single-furrow plough before putting in the mole-plough itself.

It would appear that under Rhodesian conditions the work will be most cheaply and easily done if it is carried out as soon after the close of the rainy season, as the ground surface had dried sufficiently to give a grip for the tractor or oxen. The draining should be done before the land is ploughed (in the case of arable land).

Many different methods have been used for drawing the mole-plough, and may be grouped in two main classifications: (*a*) direct traction, and (*b*) cable traction. Direct traction is to be preferred whenever the draught is not too heavy, as being simpler and quicker and avoiding the cost of the cable and winch. Moreover, it is possible to avoid obstacles such as ant-heaps. Cable haulage is economical of fuel, since the dead weight of the tractor itself has not to be moved over the wet ground, and by proper gearing very heavy draughts may be handled.

Since mole-drains are made at a much shallower depth than other systems of under-drains, it is necessary that they should be placed much closer together. In fact, experience shows that more effective drainage is obtained by a large number of shallow drains than by a few large channels at greater distances apart. The actual distance between mole-drains will depend upon the nature of the soil. English practice indicates that the drains at about 18 ins. depth should be only 3 yds. apart, but it seems probable that for Rhodesian conditions this distance could easily be doubled.

Mole-drains require a steeper gradient than tile drains—firstly, on account of the greater resistance to flow, and secondly, because it is impossible to secure an absolutely uniform gradient, since the inequalities of the ground surface are reflected in the level of the drains. As a working limit, the gradient should probably not be less than one in two hundred, and a steeper gradient is to be preferred in order

to produce a brisk flow, which will reduce the chance of clogging. The length of mole-drains of small diameter ($2\frac{1}{2}$ ins. to $3\frac{1}{2}$ ins.) is limited to about 200 yards.

Main drains, either open or piped, are required to collect and discharge the water from the moles. If a natural channel exists, so much the better. A short length of 2 in. pipe should be inserted into the end of each mole-drain where it enters an open main drain to prevent damage through the trampling of cattle.

Mole-drains are not strictly permanent, but under favourable conditions are capable of giving satisfactory service for a number of years. In certain cases in England mole-drains 30 or 40 years old are still in use, but these particular drains were $3\frac{1}{2}$ ins. in diameter and relatively deep.

Tile-draining is being rapidly superseded in England as "impossibly expensive" in comparison with mole-draining, and the difference should be still more marked in Rhodesia, since mole-draining is a method which requires very little (beyond the actual mole-plough) in the way of purchased material, and the cost is therefore almost entirely composed of labour charges. Given conditions where the draught is not too heavy for a span of oxen (or a tractor), mole-draining offers a cheap and simple means of draining a piece of rich, wet land. A number of mole-drains have been drawn on a piece of typical black vlei on the Gwebi Government farm, and comments on the results were published in the *Rhodesia Agricultural Journal* of February, 1931.

Conclusion.—While it is not suggested that under-draining on an extensive scale has been necessary or warranted in Rhodesia up to the present, there are isolated lands on a great many farms which are potentially very valuable either for pasture or arable purposes, but are, for want of drainage, only a handicap to the general working of the farm. Where these wet patches are small, it is probable that a few well-placed French drains will cure the trouble, while mole-draining is applicable to land of greater extent.

Apart from under-drainage, it is important to take steps to prevent surface water collecting and soaking into low-lying land. This is a fruitful cause of water-logging, and, if surplus

surface water is collected by a system of stormwater drains and contour ridges on the higher ground, it will be to the advantage of both types of soil.

Finally, a general word of warning should be sounded against the practice of indiscriminately ploughing up vlei lands. These lands are naturally exposed to the discharge of large quantities of storm water, and if the natural vegetative covering is once removed, there is nothing to stop the eventual formation of a large donga. The best practice is to leave a strip of 20, 30 or even 100 yards of natural grass (depending on the local conditions) in the centre of the depression, and if a channel is required for drainage purposes, it should be placed at the side.

Utilisation of Vleis.—The vleis of Rhodesia constitute a most important asset to the country, providing as they do one of the few sources of moisture available during the winter and spring and thus promoting in their vicinity green pasturage during the dry months. For the most part, however, they are capable of being rendered by judicious treatment of infinitely greater value than in their natural state. Speaking generally, they are excessively wet for the greater part of each season and are incapable of carrying summer crops or of producing grasses of high feeding value. The object of drainage is to maintain the moisture content of the land at a more uniform level throughout the year. Apart from its limited use for the growing of wheat and other winter cereals, little has yet been done towards the improvement of vlei land or its utilisation to best advantage. It may well be found that the most economic use to which most vleis can be put will be for the establishment of improved pastures, but even so some measure of drainage will usually be required.

It is necessary that the system of drainage should be as simple and cheap as possible, more so than is permissible for the drainage of good arable soil, although under English conditions no distinction is made. Leaving aside, therefore, the question of French drains and mole-drains (and, of course, tile-drains), it is obvious that some type of open drain must be used.

Where the improvement of the pasture is the objective, each case must be carefully considered on its merits, bearing in mind the type of pasture which it is desired to establish. Clovers apparently will not persist unless moisture is retained throughout the driest part of the year, within two or three inches of the surface, and white clover is more tolerant of excessive moisture than of very dry conditions. In certain cases, therefore, care must be taken not to over-drain the land, and, if mixed grass and clover pastures are desired, it may be found sufficient merely to prevent excessive water reaching the land by reason of the run-off or percolation from higher lying areas adjoining.

In other cases, and particularly on heavy clay vleis which are unsuitable for clovers owing to the rapid drying out of the surface soil in winter, the land may be laid off in wide ridge and furrow, the furrows being shallow and of an easy rounded shape so as to offer little obstacle to the use of hay-making machinery. Here, for average conditions, it is suggested that the depth of the drains or furrows should be from 1 foot to a maximum of 2 feet, and 3 to 5 yards wide, the width of the intervening ridges being 10 to 15 yards. The system should be laid out with the drains parallel and dropping at the rate of about 1 in 100, either towards the centre of the vlei or, if there is a suitable longitudinal fall, parallel to the axis of the vlei. The gentle undulating shape is important to permit easy movement of the implements and will repay a little care in excavation, which may largely be done with a plough, Martin ditcher or damscraper. The soil removed in the excavation should be spread out thinly over the elevated strip.

It is not advisable to leave the furrows to natural reversion to grasses, for this will be a relatively slow process, and meanwhile the disturbed soil will be taken possession of by weeds. Moisture-loving grasses should therefore be established in the furrows, those suggesting themselves being swamp couch grass, Hunyani grass, Rhodes grass and paspalum (*dilatatum*). The last two can be quickly established from seed, and, if this is the intention, it will be advisable to

spread a layer, a few inches deep of the surface soil (previously removed) over the face of the furrow in order to provide a more congenial medium than sub-soil, in which young grass plants may establish themselves.

Submerged Dam.—A submerged dam is a device by means of which water percolating underground is checked in its flow and brought to the surface. In other words, an artificial spring is created. The chief condition necessary for the success of a submerged dam is the existence of an impervious clay bed not far below the surface. A trench is carried down to, and into, this clay bed at right angles to the direction of percolation. The trench is then filled with good puddled clay, the thickness being proportional to the depth and not less than 3 ft. Clay for filling the trench should not be taken from the down-stream site, or there will be a risk of leakage.

A submerged dam can be used to provide a water-hole for cattle, or, if a sufficient stream of water is available, for the irrigation of adjacent land. In the latter case a small furrow is dug behind the dam and led away past one end of it.

Springs and "Sponges."—It is necessary to differentiate between the type of spring which appears usually at the foot of a steep rise at the head or side of a vlei, and the "sponge" proper, consisting of low-lying swampy ground full of decayed humus.

In the former case the vlei below the spring is not naturally a swamp, but is simply impregnated with water from the spring. If a submerged dam is made immediately below the line of springs and a furrow dug behind the dam, the spring water may be diverted from the vlei and either used for irrigation of a better piece of adjacent dry land, or may be led back to the low-lying ground whenever necessary. The vlei will then be relieved of its superfluous moisture and two pieces of land may be put to good use instead of none.

With the typical wet sponge it is usually necessary to go to the lower end and search for a place where an underlying clay bed comes close to the surface. If a submerged dam is made at this place, the sponge will continue to act as

a reservoir and should not be interfered with. If a sufficient flow of water is developed, it may be diverted by a furrow and used for irrigation.

It is not usually possible to irrigate more than an acre or two from a seepage spring or sponge, but if conditions are favourable, the submerged dam may sometimes be extended above ground level in the form of an ordinary low earth dam, which will increase the usefulness of the scheme.

Veld Burning.—Although the burning of rank grass on a vlei is occasionally a necessary measure, the general practice is one to be deprecated, since the burning of the natural covering of grass exposes the soil to the direct heat of the sun, opening up cracks (in the case of black soil) and desiccating the soil, so that the valuable asset of moisture during a dry winter is wasted by evaporation instead of being put to good use by drainage, cultivation and fertilising.

Another dangerous practice is that of opening up a spring or sponge indiscriminately, and it is strongly recommended that engineering advice should be obtained before taking any such steps.

Protein Supplements for Fattening Bullocks.

A COMPARISON OF MEAT MEAL, GROUND NUT CAKE, AND COTTON SEED.

By A. E. Romyn and R. H. Fitt.

Feeders are frequently faced with the necessity for purchasing a protein concentrate to supplement a shortage of legume hay for the fattening of bullocks. In the circumstances the choice generally lies between meat meal, ground nut cake, and cotton seed.

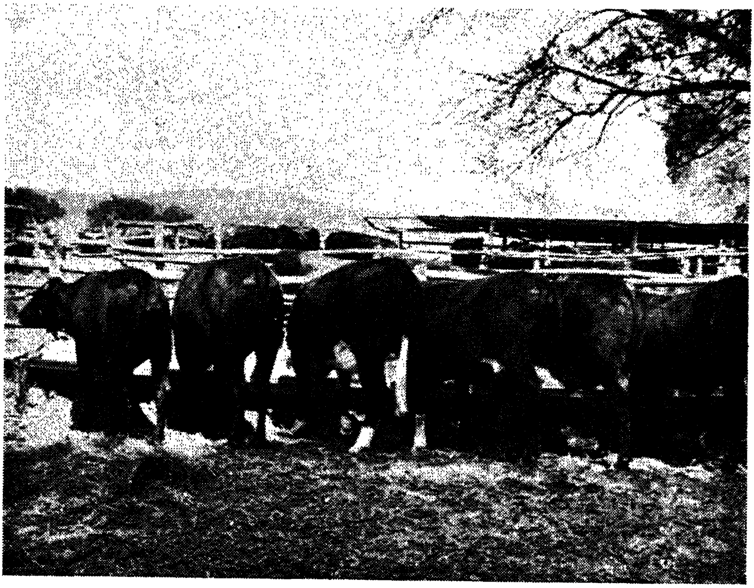
These feeds are usually considered interchangeable on the basis of their protein content, and the following demonstration was carried out from July to November, 1937, at the Rhodes Matopo Estate, to compare the feeding value of the three feeds under local conditions.

Plan of the Feeding Trial.—Thirty 4-5-year-old bullocks in medium to poor store condition were divided into three groups. Twenty-five of these steers were crossbred Aberdeen Angus-Africanders of uniform type, two were high grade Herefords and three were crossbred Africander-Zebu bullocks. The groups were evenly balanced for weight and type and are illustrated in figures 1, 2 and 3.

The maize and roughage feeds were grown on the Rhodes Matopo Estate and the protein concentrates were purchased through the usual commercial channels.

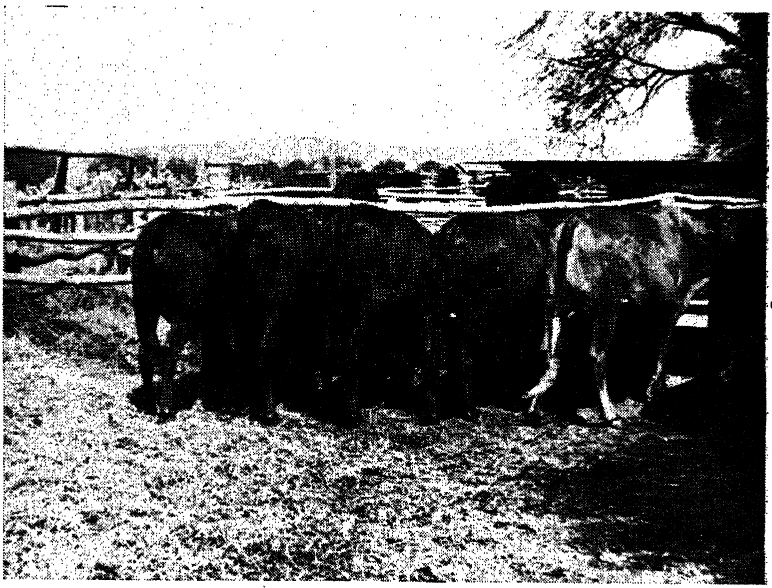
The crude protein content of these feeds as determined by the Division of Chemistry was:—

Meat Meal	79.4%
Ground Nut Cake	44.4%
Cotton Seed	16.6%



Group 1.—Meat Meal, .75 lbs. per head per day.

Group 2.—Ground Nut Cake, 1.4 lbs. per head per day.



Group 3.—Cotton Seed. 3.7 lbs. per head per day.

It will be noted that the meat meal used had a high protein content and should be distinguished from carcase meal, which is also sold for feeding purposes at a lower cost and may have a protein content of 40—42% only.

All three groups were fed maize meal, maize and sunflower silage, and veld hay. The protein was supplied by a different supplement in each group, *the amount of protein fed to each groups being approximately the same.* Thus Group 1 received an average daily ration of .75 lbs. meat meal per head per day, Group 2 1.4 lbs. of ground nut cake and Group 3 3.7 lbs. cotton seed.

The cotton seed was fed whole without grinding. The bullocks were fed twice daily, the concentrate being given on top of the silage morning and evening. A plentiful supply of veld hay was kept before them at all times. The cattle were watered once daily at troughs approximately 100 yards from the pens. The feeding pens were 11 x 15 yards in area and situated in the shelter of some acacia (thorn) trees. All the groups fed well, but two bullocks became sick, however, and went off feed, one in Group 1 and one in Group 3, soon after the commencement of the trial. They were removed from their respective groups and an adjustment made in the feeding records. In other respects all the groups were treated exactly the same and the bullocks were despatched to the Rhodesian Export and Cold Storage Company in Bulawayo by road for slaughter and export, as they reached the same degree of external finish.

The initial weights were calculated from the average of three weighings on three successive days at the start of the trial. The final weights were determined by two successive weighings on the two days before the cattle were despatched to Bulawayo.

Rations Fed.—The average daily ration for the three groups was as follows:—

GROUP 1.

Maize meal	12 lbs.
Meat meal	.75 lbs.
Maize and sunflower silage ...	7.5 lbs.
Veld hay	13.7 lbs.

GROUP 2.

Maize meal	11.5 lbs.
Ground nut cake	1.4 lbs.
Maize and sunflower silage ...	7.4 lbs.
Veld hay	15.5 lbs.

GROUP 3.

Maize Meal	8.8 lbs.
Cotton Seed	3.7 lbs.
Maize and sunflower silage ...	7.5 lbs.
Silage Veld Hay	15.7 lbs

Carcase Grading.—The carcases were graded after slaughter with the following results:—

	No. Carcases Imperial	No. Carcases Standard
Group 1	9	—
Group 2	9	1
Group 3	9	—

Discussion of Results.—For practical purposes all three rations have given the same results. Within the limits of error the rate of gain per day and the amount of feed consumed per 100 lbs. gain in liveweight are approximately the same. The bullocks were in a poor store condition to start with and fed to a high degree of finish in an average period of 92 days despite a comparative shortage of palatable roughage.

Feeding Costs per 100 lbs. gain in Liveweight.—At the time of the experiment the feed produced at the Rhodes Matopo Estate was valued as follows:—

Maize meal (including the cost of grinding)	3s 9d. per 100 lbs.
Silage	10s. per ton.
Veld Hay	10s. per ton.

The price of the purchased feeds f.o.r was as follows:—

Meat Meal	13s. 6d. per 100 lbs.
Ground Nut Cake	7s. 6d. per 100 lbs.
Cotton Seed	3s. 6d. per 100 lbs.

TABLE 1.

RATE OF GAIN IN LIVEWEIGHT AND FEED CONSUMPTION.

	No. of Steers.	Average Number of days on feed.	Average daily ration per steer (lbs. approx.)		Total feed consumption per steer.	Average initial weight (lbs.)	Average final weight (lbs.)	Average gain in weight lbs.	Average daily gain lbs.	Feed Consumption per 100lbs. gain in liveweight. lbs.	
Group 1	9	92	Maize	12	1102	1012	1188	176	1.9	Maize	626
			Meat Meal	.75	69					Meat Meal	39
			Silage	7. 5	689					Silage	391
			Veld Hay	13. 7	1263					Veld Hay	717
Group 2	10	93	Maize	11. 5	1070	1015	1195	180	1.9	Maize	594
			G. Nut Cake	1. 4	132					G. N. Cake	73
			Silage	7. 4	692					Silage	384
			Veld Hay	15. 5	1446					Veld Hay	803
Group 3	9	92	Maize	8. 8	812	1026	1208	182	1.9	Maize	446
			Cotton Seed	3. 7	344					Cot. Seed	189
			Silage	7. 5	691					Silage	379
			Veld Hay	15. 7	1444					Veld Hay	793

On the basis of these prices the feed cost per 100 lbs. gain in liveweight was:—

Group 1 (Meat Meal)	34s. 3d.
Group 2 (Ground Nut Cake)	33s. 8d.
Group 3 (Cotton Seed)	29s. 2d.

The cotton seed on this basis proved the cheapest protein supplement of the three used.

Summary.—Meat meal, ground nut cake and cotton seed when used in quantities corresponding to their crude protein content proved interchangeable as protein supplements for the fattening of bullocks—the one was as satisfactory as the other.

In the rations used, at ruling prices, cotton seed proved the most economic of the three protein concentrates.

Some Trees Shrubs, Shrubby-Herbaceous Plants, Climbers and Water Plants
SUITABLE FOR THE COLONY.

By J. W. BARNES, Manager, Government Forest Nursery, Salisbury.

(Photographs by the Author.)

The following list of trees and plants has been compiled from twenty-three years' experience of horticulture in the Colony. These trees and plants have been actually grown by the writer or have been carefully watched by him.

A large number of species has been tried at the Forest Nursery, Salisbury, during the past twelve years and experiments have been carried out with over one thousand kinds of seeds. The failure of quite a number of these seeds to germinate is attributed to the seed having been too old or to the lack of glass frames in which to raise new or sensitive seeds, which frequently arrive during the colder periods of the year. During the hot or summer season torrential rains are sometimes the cause of seed being washed away or seedlings being damaged.

The list is a comprehensive one and provides useful kinds for all parts of the Colony, and will, no doubt, be of value to people desirous of planting for timber and ornament. This article is more particularly directed to the landscape, or horticultural side of the subject, and one cannot help being struck by the fact that, in this country of large holdings, more is not made of a proper lay-out round homesteads than is the case at present. Most people seem contented with a small shrubbery of formal aspect, whereas much better results would be obtained from a more generous treatment of the subject.

Where there is sufficient space large shrubberies could be laid out, care being taken not to have many straight lines but rather to employ curved banks of shrubs and trees backing lawns, or even the ordinary veld grass, kept cut by the mower.

A judicious use of the larger trees, such as *Cupressus torulosa, Eucalyptus citriodora,* and others will help to break up the formal look and give the lay-out a natural appearance.

Shrubs and trees for ornament are usually planted too closely together. Near the edge of the shrubbery should come the smallest growers, which may be planted at six feet apart, and farther back the larger shrubs which will require more room and may be planted from ten to fifteen feet apart. If large trees are to be planted they will require wider spacing. However, all this is dependent on the effect required. If large splashes of colours are required, or deep masses of green, three or four plants of ach kind may be planted from six to ten feet apart according to species, in clumps, but care should be taken that each species has room enough to develop properly. When first planted a shrubbery will have the appearance of having too few plants in it, but in a year or two it will be found that the ground is more or less covered.

Preparation of soil for planting is important. Where a plough can be used the soil may be turned up as deeply as possible and should be worked to a depth of eight to ten inches. Even with deep ploughing it is advisable to dig holes eighteen inches square and the same depth, filling in with good surface soil in which some old manure has been mixed.

The soil should be allowed to settle for a month or two. Care should be taken not to plant too deeply. The roots should be just covered. A good soaking of water if the weather is dry is necessary after planting, and grass thrown over the plants for a day or two will help. It should be remembered that plants are living things and can easily be killed, but when treated with respect they will be a credit to the grower.

It does not seem to be generally known that most flowering shrubs prune well, and that good results are obtained by judicious pruning. This operation is best carried out in early September, or just as the buds of Spring growth are breaking. It is a mistake in this hot climate, without a well defined

dormant season, to prune shrubs or roses as early as May or June. They should be induced to rest as long as possible by withholding water and pruning. The result of early pruning is to start new growth prematurely and hence the short and unsatisfactory lives of some kinds.

In pruning shrubs it is not necessary to cut back severely unless the future effect would warrant it, and pruning should always be carried out with an eye to the effect desired at the time of flowering. In some cases, only long straggly growth need be shortened.

After the annual pruning there should follow a general dig-over, when the soil is broken up to a depth of at least three inches. It should be left in a rough state to enable air and early rains to penetrate.

Manure should be dug in round the plants within a radius of five feet of each, using it generously if sufficient is available.

During summer months it will be necessary to clean up weeds; these may be hoed up and buried in the shrubbery where in time they will become valuable food for shrubs. Arboreta, or shrubberies, are much the cheapest way of beautifying a homestead, and much less upkeep is required than for the same size of flower garden. This does not, of course, mean that one should dispense with a flower garden. A properly laid out shrubbery will enhance the flower garden, in providing good backgrounds and wind breaks.

A good dressing of lime about every fifth year is beneficial. At least one ton of lime per acre should be used, and in addition common salt in the proportion of one to three of lime is recommended. When lime is used kraal manure must be left out, as these must not be used together.

Hedges.—Most hedging is planted at one foot apart for single line hedges. Single line hedges are the rule, but double row hedges can be used if extra width is required.

The preparation of the trench is important, and will make all the difference between success and failure. Trenches eighteen inches wide and the same depth should, if possible, be dug three months before planting and should be filled in

with good surface soil. Subsoil removed from the bottom part of trench should be discarded. Old manure, leafmould, etc., mixed in the soil will be very beneficial. The trench should be filled in as soon as possible, and left raised about three inches above the surrounding soil level. In two or three months it will have settled down to the proper level, and is then ready for the plants. If the soil is dry at the time of planting a good soaking overnight will put the soil into good planting condition.

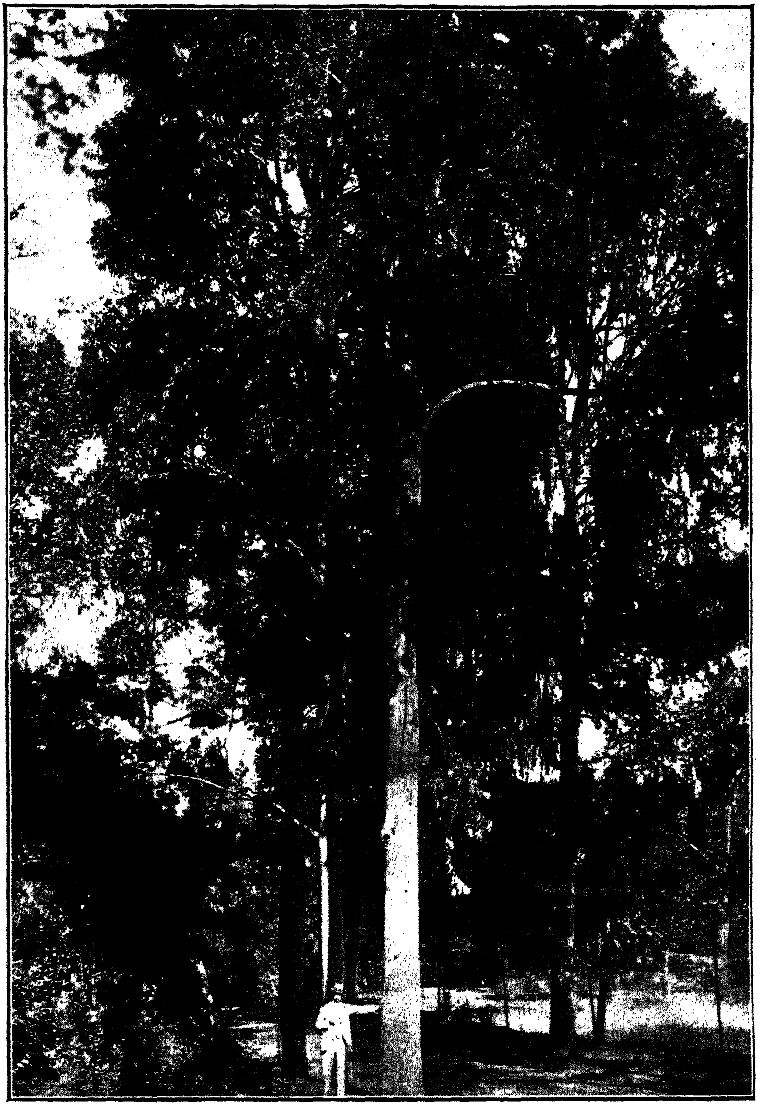
The after-treatment of hedges is important. In the case of coniferous hedges, such as Callitris, Cupresses, etc., they may be allowed to grow to the height required before having their tops cut off. Future work with these will be the shaping of the sides as the hedge thickens out and keeping the top cut neatly. In two or three years an excellent and close hedge will result.

With such subjects as Privet, Bottle Brush and Dodonea, the plants require topping when they have become established and half of the top growth should then be removed. Thereafter topping should be a regular operation and as the hedge grows a foot from the last cut, it should be again cut back half way. In this manner a good thick hedge will be built up and will not show bare unsightly sticks at the base. Camphor laurel should be treated not quite so severely as the former kinds. It is a good plan to take the smallest healthy plant in the hedge as a guide, and to shorten back the growth of the others, so that all are brought on about the same size.

All of these hedges are recommended to be planted at one foot apart.

Bougainvillea, Macartney Rose and Golden Shower make excellent hedges, and make a delightful show when in flower.

The Bougainvillea planted at six feet apart will make a thick hedge, the long shoots as they grow must be tied into the fence wires, and spaced evenly about six inches to a foot apart so as to cover all the space. After the frame work is built up, future treatment will be the clipping off of all growth not required, which is usually done in such a way to keep the hedge about a foot or two wide.



Eucalyptus maculata (Spotted Gum).—Fine trees growing in the Public Gardens, Umtali.

The Macartney Rose can be treated as the Bougainvillea and planted at the same distance apart. This is a particularly fine thorny hedge, and excellent round orchards and places were it is required to keep out cattle. If no blank spaces occur in the hedge nothing will penetrate it. The Macartney Rose makes a cheerful sight in early Spring with its large white single flowers.

Both the foregoing hedges must receive regular attention and as a result will always look neat. If, however, they are neglected they become very unsightly.

The Golden Shower may be planted at nine feet apart along a fence, in large well prepared and well manured holes. As the plants grow the leading shoots can be tied-in, erect to the top of the fence, and then tied down along the top strand of wire as it grows until it reaches the next plant; side shoots from this main stem will then droop to the ground and make a fine showy and neat screen.

Avenue or Street Trees.—The tendency of the past has been to plant street or avenue trees too closely together, and to allow them to branch too near the ground. Such trees as Cedrela, Jacaranda and Flamboyant need to be at least thirty feet apart, and the Flamboyant could be planted at 35 to 40 feet with advantage, as it is naturally a flat topped and wide-spreading tree.

For street planting especially, these trees should be grown with a clear stem to at least seven feet high, before being allowed to form a crown.

The practice in past years has been to let street trees branch more or less where they liked, the consequence being that some trees have formed a crown about four feet from the ground, while others, particularly the Jacaranda, have run up to nearly ten feet. In these days of fast motor transport these trees constitute a real danger, as a clear view is often obscured by low branches. The danger is increased at night. In Salisbury a lot of the trees have had to be pruned severely with the consequent spoiling of the appearance of the trees, however skilfully done. This would not have been necessary had the trees been grown correctly in the first instance. The Flamboyant (*Poinciana regia*), which is now being largely

planted in streets is, as has already been remarked, a very wide-spreading tree, and is very inclined to branch near the ground, unless the branches are removed well up before allowing the crown to form. The Flamboyant may have to be removed in a few years, except in very wide streets.

From experience gained in the past we should endeavour to improve our cultural methods.

Cedrela and Jacaranda can be kept in shape by pollarding all straggly branches. An annual cut back of these would improve their appearance considerably, and prevent branches from encroaching on private stands, and would also keep the tops of the trees in uniform shape. It should be borne in mind that street or avenue trees are meant to provide shade and beauty and when they reach this stage they should be regularly kept in order.

The Spathodea is not so rank-growing as the former. It should be planted at twenty-five feet apart, and taken up to seven feet before heading, and large straggly shoots may be shortened after flowering.

The Bauhinia is not so large and can be planted at twenty feet apart and planted where it can be allowed to form low branches, but it is not really suitable alone. It may be planted as a front line in wide roads where two lines are required and where there is plenty of room between the curb and sidewalks. It would be a pity to discard this tree as it is delightful when in flower.

Grevillea robusta, or Silky Oak, is also used as a street tree, and where it thrives is a suitable tree. However, a good deal of cleaning up is necessary on account of a continual fall of old leaves. Thirty feet would be a suitable spacing for this tree.

It is most necessary to stake securely all avenue trees during the first few years, or until there is no danger of their being blown over by the wind.

In laying out private avenues care should be taken to allow at least thirty feet width of road between the trees. If the trees are required to meet over the middle of the avenue, the Flamboyant or Cedrela will easily cover this distance.

Instances have been seen where only a width of twenty feet or less has been allowed for the avenue, and the trees permitted to branch near the ground, making it often difficult to pass traffic on such avenues.

Should a bottom screen be required for such avenues a double line of Cypress, Callitris, or even Eucalpts, may be planted to provide a screen, but these should be planted at least fifty feet back from the avenue trees to allow them to develop properly.

Specimen trees on lawns, etc., require abundant space in which to grow naturally, and the different species should each be planted in places to suit them. Other small shrubs or rank-growing flowers must not be planted near these while small, as the shade caused may easily damage the lower branches of the specimen, and, of course, a perfect specimen depends on its branch formation for its beauty. To spoil the lower branches is to ruin the look of a specimen tree, and this is particularly so with the Cypress or Araucaria. In the case of specimen trees, like Flamboyant, which have been allowed to have clear stems, flowers may be grown around the base, but stones and soil should not be heaped around these trees, otherwise the tree will be killed in a few years.

Trees should be securely staked until strong enough to stand ordinary winds.

Propagation of Species.—Most kinds of trees and some of the shrubs are easily raised from seed if ordinary care is taken.

The usual practice at the Forest Nursery is to sow seeds in half petrol tins which are ready for use when a few holes have been puched through the bottom.

Soil for the raising of seeds should consist of two parts of good ordinary soil, one part of leaf mould or road sweepings, and one part of sand. This mixed soil should be passed through a quarter inch sieve and the tins filled with it. The tins should be placed on a level surface, and the soil pressed in firmly with the hands and levelled off. The next step is to take a flat piece of wood, or even a brick, and press the surface firmly so that a smooth surface results. Everything is now ready for sowing. The seed should be sown thinly, care being taken to have an even covering of seed. The seed should

be covered, barely out of sight, with a fine soil ,which can be prepared from the same soil used for the tins, but put through a piece of mosquito gauze to remove all coarse stuff.

After sowing the tins must be shaded with hessian or grass and kept moist until the seeds germinate. The after-treatment is simply potting up the seedlings when large enough, using the same compost as for the seeds, shading the plants until well established, and then standing them out on a level space in full sunlight. If the plants have been raised in heavy shade it may be necessary to harden them to the sun, gradually.

The golden rule in sowing seed is to cover each species to the depth of the seed only. In the case of fine seeded Eucalyptus this is a mere sprinkling of soil only, and some omit even this.

It is very important that after the first watering the surface of the seed pans must not get dry, even for an hour. On the other hand they must not become saturated with water.

The best times of the year to raise seeds are from March to May and August to November.

Raising Plants from Cuttings.—Some varieties of trees and shrubs which do not seed freely are raised by cuttings, and by cuttings is usually meant ripened wood of the previous season's growth, although young shoots are sometimes struck.

The cuttings may be from six to nine inches long and may be cut off straight at the top, but with an oblique cut below a bud at the base. At least two-thirds of the cutting should be inserted in sand, or three parts sand and one part fine soil. Cuttings may be placed fairly closely together and half a petrol tin cut depthwise will easily take one hundred cuttings.

The tins of cuttings must be moistened frequently, but care should be taken that they do not become too wet; stand the tins in a warm corner in the shade, and in a month or two the plants will be ready for potting up. Some of the cuttings may even then have no roots, but if the base of the cutting is callused it will probably root. The rooted cuttings should be firmly potted and kept in partial shade until firmly established.

A good time of the year to take cuttings is from July to September.

The mode of propagation of the various species is given in the following list:—

Abelia floribunda.—A hardy shrub up to six feet high, with shining myrtle-like leaves; flowers small pinkish white bell-shaped and produced in profusion in Spring; evergreen when watered during the dry season; is not recommended as a hedge. Hardy. Propagated by cuttings.

Aberia caffra (Kei Apple).—A thorny slow-growing shrub, formerly used for cattle proof hedges; foliage dark green and fruits yellow, being similar in size and colour to apricots; these are edible, and used for preserves. Seeds.

Abutilon sp. (Chinese Lantern).—A well-known shrub with lantern-like flowers variously coloured; will grow to height of 8-10 feet, but is best kept to about five feet by pruning yearly; is not a long-lived shrub, usually dying out in about four years. Will not stand heavy frost. A variegated foliage variety is very handsome. Seeds or cuttings.

Acacia Baileyana (Bailey's Wattle).—A small tree, not very long-lived in the hotter districts, but well worth growing for its beautiful foliage and yellow flowers; height about 15 feet; spreading habit; at its best along the Eastern Border of the Colony. Seeds.

Acacia cultriformis.—A bushy variety, about eight feet in height, with small stiff glaucous leaves; flowers freely, and is very hardy. Seeds.

Acacia dealbata (Silver Wattle).—A similar tree to *mollissima,* but with silvery green leaves; will only do well in the same districts; is inclined to become a pest at Inyanga, as seeds carried by flood water during the rains have carried for miles and have germinated all over the place. Seeds.

Acacia melanoxylon (Blackwood).—A very fine large tree, valuable for its timber; heavy dark green foliage, and insignificant pale yellow flowers; is suitable only along the Eastern Border. Seeds.

Acacia mollissima (Black Wattle).—Is a fast growing tree up to 40 feet in height; dark green foliage; lemon coloured flowers. Grows to perfection only along the Eastern Border or mist belt areas and produces valuable tanning bark. Seeds.

Acalypha macrophylla.—With large blotched leaves about 9 inches x 6 inches in size when well grown; a very handsome variety, showing up well in a dark green background. Cuttings.

Acalypha marginata.—Grown for its ornamental foliage, which is red-green with the margins of the leaves red; height 8 feet; grows best in a partially shaded situation, and should be protected during frost. Cuttings.

Acocanthera venenata (Poison Bush).—A South African shrub, about 8 feet in height with dark green leaves; branches covered with axilliary, pinkish white flowers; purple plum-like small fruits.

All authorities state that this shrub is very poisonous, and therefore not recommended.

Acrocarpus fraxinifolius.—A medium-sized tree about 30 feet in height; deciduous, spreading crown; resembles Cedrela; is used in some countries as a shade tree for coffee, and it will probably be of use in this country for that purpose. Seeds.

Actinidia chinensis.—A strong-growing, rough climber, with large deciduous leaves, and rather insignificant pale yellow flowers; said to bear an edible fruit, but out plants at the Forest Nursery have so far been males. Seeds.

Adhotoda duvernoia (Pistol Bush).—An evergreen shrub, 6 to 10 feet in height, tender to frost, and with pinkish-white flowers. Cuttings.

Agapanthus umbellatus (African Lily).—A well known plant, which although not a shrub, is usually used in shrubbery work, where it is very useful near the edges of the shrubbery. Seeds or offsets. fi

Agave americana (Aloe).—The American aloe with large leaves which are glaucous-green and fleshy; useful on rockeries and in shrubberies. Suckers. A variegated variety which is very showy is used in shrubberies.

Agave rigida (Sisal).—Both the plain and spiny-leaved kinds grow to perfection; leaves from three to five feet in length; are very useful for thatching and tying purposes. Natives crush the leaves slightly and strip them down to make "tambo," which for thatching purposes lasts as long as the thatch. Bulbils or suckers.

Aleurites fordii (Tung Oil).—This tree was first raised in Salisbury in 1923 and one or two trees six to eight years of age have grown slowly; a large deciduous tree with large maple-like leaves, and bearing a nut similar to the chestnut, from which a valuable oil is extracted. Will probably be found to thrive best in the Melsetter area. Seeds.

Aleurites montana.—Similar to *A. fordii*, and to which the same remarks apply.

Aleurites triloba.—One or two trees of this have done very well in Salisbury, planted about twenty years ago, and one tree now about 30 feet in height and very healthy. Seeds. Propagation difficult.

Allamanda grandiflora.—A beautiful golden flowered variety, and a strong climber, suitable as a verandah climber. Cuttings. Propagation difficult.

Allamanda neriifolia.—A shiny leaved shrub, 3 to 6 feet high, with bell-shaped yellow flowers. Evergreen. Seeds or cuttings.

Allamanda violacea.—A very fine violet-purple variety of rather small size, being about 4 feet high, best treated as a shrub, any long shoots being tied in, or cut back. Cuttings. Propagation difficult.

Althæa sp.—A small shrub up to 6 feet high, allied to Hibiscus; several varieties, some with single flowers, light purple and white, others with double flowers; found to do best in partial shade. Hardy. Deciduous. Cuttings.

Alysia citriodora (Lemon Scented Verbena).—A small bush usually about 4 to 6 feet; flowers insignificant, white; grown for its scented foliage. Deciduous. Cuttings.

Alstonia scholaris.—A small shrub about 6 feet in height; resembling oleander, with bunches of pure white flowers, evergreen. Seeds.

Ampelopsis quinquefolia.—A large-leaved variety, of much coarser habit than *A. veitchii* and very hardy. Seeds and cuttings.

Ampelopsis veitchii (Virginia Creeper).—A climbing plant suitable for walls and rocks, to which it clings; proved to do best in this country on south walls. Seeds or cuttings.

Anona reticulata (Custard Apple).—A small tree, deciduous, with excellent edible fruits; seems to thrive and fruit best if the seeds are sown "*in situ.*" Seeds.

Antigonon leptopus (Coral Creeper).—A beautiful sight when a large plant is in full bloom; strong grower, deciduous and rather unsightly during the winter, unless grown with some other evergreen climber which will not kill it. Seeds.

Araucaria bidwillii.—Very different in habit from *A. excelsa* and *A. cookii;* it has short, stiff sharply pointed leaves, very similar to the true monkey puzzle (*A. imbricata*).

A. bidwillii has grown well in Bulawayo; Araucarias are very hardy with the exception of *A. imbricata,* which has failed. All Araucarias raised from seeds.

Araucaria brasiliensis.—A tree similar to the true Monkey Puzzle, *A. imbricata,* and a handsome specimen tree. Some have survived in Salisbury, and a few trees are to be seen about 20 feet high; this tree, however, is inclined to die out in hot districts, but will undoubtedly do well in the Eastern Border Districts.

Araucaria cookii.—A similar tree to *A. excelsa.*

Araucaria cunninghami (Moreton Bay Pine).—Has glaucous foliage and is not of such formal growth as other Araucarias owing to the branches having a more tufted appearance.

Araucaria excelsa (Norfolk Island Pine).—A large tree which will probably grow to a height of 100 feet; is used chiefly as a centre piece for lawns, and is a fine tree for use in large landscapes.

Aristolochia elegans..—Not so strong-growing as *A. sipho,* and with much smaller, brownish-red, flowers. Seeds.

Aristolochia sipho (Dutchman's Pipe).—A strong climber, growing to a height of 25 feet, with curious flowers, of a purplish colour. Hardy. Seeds.

Aristolochia tomentosa (Dutchman's Pipe).—A strong grower, requiring plenty of room; crimson-purple flowers. Deciduous. Seeds.

Arundo donax (Spanish Reed).—A strong reed, up to 25 feet in height in a good soil with plenty of moisture; has a diameter of an inch and is very useful for garden sticks and numerous other purposes. Offsets. A variegated variety is very ornamental.

Asparagus plumosus (Asparagus Ferns).—This plant grows to perfection with very little effort, and varieties are to be found growing in the veld. Seeds or divisions of roots.

Asparagus spengeri.—A useful kind for hanging baskets; fronds about two feet in length and has at one period of the year tiny white flowers. Scented. Division of roots or seeds.

Bambusa arundinacea (Whipstick Bamboo).—The stems of this species are up to 50 feet, when grown in heavy rich soils and have diameters up to 5 inches; for whipsticks it should be grown in poor or gravelly soil. Offsets.

Bambusa fortunei (Fortune's Bamboo).—A small variety having a height of about 6 feet and stems about half an inch thick; valuable in clumps in a shrubbery and can also be used as a hedge; stems are very handy as stakes in a garden. Offsets.

Bambusa vulgaris.—A strong-growing bamboo, with blackish stems 2 to 3 inches in diameter, and 15 feet high. Offsets.

Bambusa sp. (Striped Bamboo).—Height to 15 feet, diameter 3-4 inches; has golden stems marked with green stripes. Offsets.

Bambusa sq.—An Indian species raised from seed brought over by Mr. A. C. Laurie, Glendale, and though not yet fully grown has reached 20 feet in height. Offsets.

Bauhinia acuminata.—A pure white variety similar to *B. purpurea*, and used for the same purposes. Seeds.

Bauhinia galpini (Pride of the Cape).—Should be called Pride of Rhodesia, as it occurs abundantly in portions of the Colony. There are several indigenous Bauhinias.

This is a rambling, climbing shrub and loves to climb over other trees, where it will reach a height of 30 feet; flowers are terra-cotta coloured and shaped like nasturtiums; when in bloom is very effective. Hardy. Seeds.

Bauhinia purpurea.—A small showy tree 15 to 20 feet in height, with Rhododendron-like flowers, which are pinkish-mauve in colour and scented; flowers May-July, at a time of year when there are otherwise few flowers. It is used for streets and avenues, when it should be planted at 20 feet apart, and is also a very fine small tree for shrubberies. Seeds.

Beaumontia grandiflora. — A large-leaved, vigorous climber, which requires plenty of room. One plant will easily cover a trellis 25 feet in length and 10 feet high; a quick grower, and flowers profusely; flowers large, trumpet-shaped and pure white, being very similar to *Lilium Harrisii;* sometimes a little slow in becoming established. Seeds.

Bignonia cherere.—A beautiful large flowered reddish-orange species; strong grower and climber. Propagation by layers, or budding.

Bignonia gracilis.—A climber which will cling close to walls and trees, like Virginia Creeper, and is very useful when a plant is required to cover a dead tree stump. Has large sulphur yellow flowers, but only in flower for a short period yearly. Cuttings or seeds.

Bignonia jasminoides.—A good climber which has evergreen bright shining leaves and large white flowers with purple throat. Seeds or cuttings.

Bigonia speciosa.—A dwarf ground runner 2-3 feet in height and having mauve flowers. Cuttings.

Bigonia venusta (Golden Shower).—Grows to perfection nearly everywhere; this gorgeous climbing plant is too well known to need description. Excellent alike for verandahs, pergolas, or even as a hedge, when it makes and wonderful show. Cuttings.

Bixa orellana (Arnatto).—A dark green shrub, 6-8 feet in height with rather pretty pink flowers; dense foliage; evergreen. A dye is obtained from this which is used in colouring cheese. Seeds.

Bolusanthus speciosus (Rhodesian Tree Wistaria).—A small indigenous umbrageous tree, 15-20 feet high, covered in Spring with panicles of intensely blue flowers similar to the Wistaria, but smaller. Seeds.

Bougainvillea splendens.—This species and several others of this genus do remarkably well, and are useful as strong climbers; if trimmed into neat bushes, they make effective shrubs, and also make excellent hedges if kept in order. Layers or cuttings.

Brugmansia knightii (Moonflowers).—Makes a fine shrub 10-15 feet high. It has large single highly-scented flowers during summer. It requires protection in winter while small, as heavy frosts cut it back. A double variety is also grown, but not so strong in growth, height 6 feet. Seeds or cuttings.

Brunfelsia americana.—A small bush up to 6 feet in height. A variety with whitish-yellow flowers, over an inch in diameter; flowers in early Spring. Cuttings.

Brunfelsia eximia (Yesterday-To-day-To-morrow).—The uncommon name of this plant is owing to the fact that the flowers turn a different colour daily. They are at first a fine violet-purple. A small slow bush, up to above 6 feet in height, but a beautiful sight in early Spring when covered with flowers which are also scented. Seeds or suckers.

Buddleia sp.—Several varieties of Buddleias are grown, and thrive, some with blue to purple flowers; flower in the Spring, and grow up to 10 feet in height.

An orange-flowered species grows rankly to a height of 15 feet and flowers in June-July. Flowers sweetly scented.

An indigenous variety, *B. salviæfolia*, flowers in May-July, and has pinkish-purple scented flowers, and is a common shrub on the Eastern Border. Seeds or cuttings.

(*To be continued.*)

Southern Rhodesia Weather Bureau.

JANUARY, 1938.

The weather services in Northern and Southern Rhodesia were combined from the 1st January, 1938, and a few stations from the former country are included in this report. This number will be steadily increased as the equipment in the North is brought up to date.

Pressure.—Barometric pressure was generally slightly below normal over the whole country.

Temperature.—Maximum temperatures were slightly below the average but minimum temperatures were generally above. Humidity was well above normal everywhere.

Rainfall.—Rain continued with slight intermissions in the south through the whole month and the total was nearly three inches in excess of the average, bringing the seasonal rainfall to approximately two inches above the average.

Weather and Air Masses during January.—The month was generally wet, particularly in the northern part of the Colony, where some stations recorded rain on every day of the month. Equatorial air was predominant, the main source during the first three weeks of the month being the Indian Ocean to the north of Madagascar. The weather during this period was characterised by an unusual amount of thunder for the time of the year.

There were incursions of maritime air into the south on the 7th, 10th, 16th, 23rd and 28th.

The establishment of the S.E. trades resulted in fair weather in the south from the 1st to the 4th, from the 17th to the 20th, and on the 24th and 25th.

A tropical cyclone formed over the north of the Mozambique Channel on the 8th, but was short-lived, having disappeared on the 10th. While it existed weather was unsettled in Southern Rhodesia.

A very deep southerly low on the 12th induced a flow of dry air across the West Coast from the Atlantic. The dry air approached the Rhodesian border on the 14th, but failed to cross.

A deep low formed over the south-west of the Colony on the 30th and moved north-westward, being followed by cold southerly air. A good deal of heavy rain fell on the last two days of the month.

PRECIPITATION.

Stations.	Inches.	Normal.	No of days.
Beitbridge	6.14	3.21	8
Bindura	16.88	7.39	24
Bulawayo	6.10	5.61	16
Chipinga	11.56	10.38	19
Enkeldoorn	12.96	7.63	23
Fort Victoria	10.24	6.14	17
Gwaai Siding...	7.75	5.41	16
Gwanda	5.68	5.53	15
Gwelo	6.64	5.99	20
Hartley	12.69	7.74	23
Inyanga	15.47	9.92	27
Marandellas	19.52	8.56	24
Miami	9.40	8.25	27
Mount Darwin	8.85	8.25	20
Mount Nuza	25.82	14.59	30
Mtoko	10.83	7.77	24
New Year's Gift...	7.81	7.65	18
Nuanetsi	7.84	4.33	14
Plumtree	5.12	6.30	15
Que Que	11.16	6.83	16

Stations.	Inches.	Normal.	No of days.
Rusape	21.53	7.56	24
Salisbury	12.15	7.37	26
Shabani	4.13	5.87	15
Sinoia	11.27	8.14	26
Sipolilo	4.94	8.52	24
Stapleford	26.19	16.81	30
Umtali	14.70	8.11	25
Victoria Falls	5.89	6.95	17
Wankie	11.93	6.49	21

JANUARY, 1938

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	8-30 a.m. Wet Bulb.	8-30 a.m. Dew Point	8-30 a.m. Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
ɔridge...	1,500	78.3	71.1	68	10.0	90.2	71.4	80.8	103	6th	64	3rd	25	...	29	...	80.2	961.0	880.0	...	4.7	...
.ura...	3,700	70.3	66.5	64	5.0	80.2	64.5	72.3	86	14th	59	4th	1	...	10	...	70.5	889.1	...	...	5.7	...
wayo	4,393	68.4	63.7	61	5.5	80.5	61.4	70.9	87	14th	56	3rd	6	...	1	...	...	867.2	878.5	...	6.5	...
inga	3,685	70.2	66.1	64	4.9	78.3	62.3	70.3	87	14th	57	1st	2	...	2	...	69.0	890.2	879.7	...	4.7	...
ɹldoorn	4,788	67.8	63.7	61	4.7	78.2	60.7	69.5	87	14th	55	1st	1	...	...	...	67.8	855.3	878.6	...	5.8	...
Victoria... ...	3,571	72.3	66.1	63	7.7	81.6	63.3	72.5	91	6th	56	1st	9	...	7	...	71.5	892.8	878.8	...	4.9	...
ai Siding... ...	3,278	72.1	67.1	64	6.4	87.5	65.3	76.4	94	5th	59	19th	22	...	17	...	...	901.5	878.4	...	5.7	...
nda...	3,233	73.4	66.6	63	8.5	84.2	64.8	74.5	93	5th	60	1st	15	...	13	...	73.6	903.6	879.0	...	4.4	...
ˡo	4,629	68.6	64.0	61	5.3	79.7	61.2	70.5	87	6th	56	1st	3	...	...	...	69.2	860.1	878.5	...	4.9	...
ley...	3,879	70.5	65.6	63	6.2	80.2	63.5	71.9	88	14th	58	4th	1	...	3	...	70.6	883.1	878.6	...	6.2	...
ɿga...	5,503	66.8	62.5	60	5.0	74.4	58.3	66.3	80	14th	53	5th	...	...	...	...	64.8	...	...	...	5.4	...
.ndellas	5,453	66.2	61.9	59	4.8	74.5	59.2	66.8	83	14th	55	2nd	...	1	...	...	65.0	...	...	...	4.3	...
ıi	4,090	68.3	65.6	64	3.3	78.2	63.7	70.9	84	6th	61	6th	...	...	3	...	69.7	876.6	878.6	...	6.2	...
Darwin	3,179	71.7	68.0	66	4.6	81.2	66.3	73.7	86	6th	62	3rd	1	...	20	...	72.1	905.1	...	...	6.7	...
ıt Nuza	6,668	59.0	57.8	58	1.2	65.9	54.0	60.0	75	14th	47	11th	...	25	...	...	58.8	799.9	878.6	...	6.7	...
:o	4,141	69.0	65.1	63	4.8	77.2	62.0	69.6	81	6th	58	1st	...	1	1	...	68.1	875.3	878.9	...	5.3	..
Year's Gift...	2,690	73.7	68.8	66	6.6	83.5	64.6	74.0	94	14th	58	5th	12	...	10	...	...	...	...	...	...	5.8
etsi	1,581	77.1	71.7	69	7.4	87.6	68.6	78.1	100	14th	60	3rd	18	...	23	...	...	958.9	879.7	...	4.9	...

JANUARY, 1938 (continued)

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F																Pressure Millibars			Cloud Tenths	Sunshine Hours
		8-30 a.m.				Maximum	Minimum	Max. + Mim. ÷ 2	Absolute				Number of Days				Mean of 24 hours	8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours		
		Dry Bulb.	Wet Bulb.	Dew Point	Vapour Press. Deficit				Maximum	Date	Minimum	Date	Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°						
lumtree	4,549	70.2	64.0	60	7.2	80.5	62.6	71.5	87	5th	59	1st	5	...	2	...	70.3	861.6	...	...	4.2	...
ue Que	3,999	70.1	66.0	64	4.9	82.3	63.5	72.9	90	14th	58	1st	6	...	3	...	71.5	879.5	878.7	...	6.6	...
usape	4,648	67.2	63.6	61	4.2	76.6	61.1	68.9	83	14th	57	1st	...	...	1	...	69.9	...	...	...	5.8	...
alisbury	4,831	67.5	63.2	61	5.0	77.7	60.9	69.3	84	14th	55	4th	...	...	...	...	67.5	854.1	878.5	852.8	8.5	5.6
ıabani	3,131	73.7	67.5	64	7.7	84.2	65.1	74.6	95	14th	58	2nd	13	...	16	..	73.4	...	...	...	4.1	...
inoia	3,795	71.2	66.8	65	5.7	81.1	64.5	72.8	87	14th	59	4th	1	...	6	...	70.5	886.1	879.0	...	5.2	...
polilo	3,876	70.4	65.9	63	5.6	78.5	63.3	70.9	86	14th	60	4th	1	...	2	...	...	883.0	878.7	...	5.1	...
apleford	5,304	64.4	62.0	61	2.8	71.7	57.2	64.5	81	14th	50	11th	...	7	...	...	63.4	840.3	878.9	...	6.2	...
mtali	3,672	71.2	66.6	64	5.7	82.3	63.5	72.9	93	6th	58	5th	7	...	5	...	71.0	890.3	879.4	889.2	5.2	5.7
ictoria Falls... ...	3,009	73.7	69.2	67	6.0	87.8	67.7	77.8	96	5th	65	3rd	20	...	27	...	76.2	909.4	878.5	...	4.3	...
ankie...	2,567	76.0	69.9	67	7.9	89.5	70.1	79.8	100	6th	67	23rd	23	...	31	...	78.1	924.1	878.5	...	5.3	...
bercorn	5,407	66.7	62.5	60	4.8	76.0	59.3	67.7	83	2nd	50	12th	...	2	...	...	...	836.9	879.3	...	4.1	...
oken Hill	3,920	67.1	65.5	65	1.8	79.7	64.1	71.9	85	6th	61	31st	...	...	4	...	...	882.5	878.7	...	9.5	...
ısama...	4,700	68.3	64.6	63	4.9	80.5	61.7	71.1	86	5th	58	19th	4	...	1	...	...	863.4	879.1	...	...	...
vingstone	3,140	71.3	68.1	66	4.2	84.3	66.0	75.1	94	5th	62	3rd	12	...	18	...	...	905.5	879.2	...	6.0	...
ongu	...	71.2	68.5	67	4.6	84.1	66.8	75.4	92	15th	64	19th	11	...	25	...	...	895.0	878.1	...	...	...
pika	...	67.9	65.0	64	3.6	78.5	61.8	70.0	83	10th	59	1st	...	...	...	...	...	861.1	879.0	...	7.1	...
lola	4,140	66.4	64.9	65	1.8	79.6	62.6	71.2	84	15th	61	2nd	...	...	...	...	...	874.1	879.1	...	6.6	...

Rainfall in January, 1938, in Hundredths of an Inch. Telegraphic Reports.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total	Normal
...	...	...	...	...	126	2	7	53	24	22	44	5	5	10	25	1	...	...	1	...	8	6	1	4	17	40	3	42	82	78	606	533
...	...	7	17	...	42	39	...	94	5	61	23	11	32	42	39	6	...	...	4	...	80	7	5	...	26	84	16	...	199	125	964	742
2	1	11	9	28	17	113	...	119	9	17	78	14	6	43	184	27	1	9	...	3	79	...	14	...	67	152	15	...	113	207	1338	1087
...	...	31	4	21	96	33	...	63	36	5	2	11	22	107	28	38	...	2	31	...	34	3	2	1	94	60	36	74	145	105	1084	697
...	...	7	1	...	22	38	...	79	50	22	52	4	5	3	23	22	24	4	31	...	25	5	8	5	24	15	2	22	28	244	765	663
...	...	28	140	6	34	9	45	61	15	48	1	6	64	74	27	33	...	61	16	...	55	13	14	12	122	86	108	75	43	157	1353	746
3	6	29	32	24	25	64	75	91	69	134	81	26	15	20	71	23	2	147	33	17	71	22	3	30	76	86	100	96	104	131	1706	911
4	22	72	46	21	5	27	28	102	127	31	17	25	39	37	22	37	8	30	32	15	31	13	38	112	110	81	85	97	7	11	1332	835
25	4	19	13	34	4	27	16	31	26	27	14	6	91	34	29	25	35	19	12	2	11	6	70	34	60	101	13	138	14	63	1003	855
21	8	54	28	9	48	45	1	...	162	45	24	7	3	65	30	41	2	...	45	...	53	3	2	11	58	55	86	31	32	15	984	824
5	2	18	27	11	50	30	17	65	40	42	33	9	30	37	34	21	9	26	19	2	38	8	15	14	55	64	38	58	77	123	1017	730

Southern Rhodesia Veterinary Report.

DECEMBER, 1937.

DISEASES.

No fresh outbreaks of scheduled diseases.

TUBERCULIN TEST.

Four bulls were tested upon importation with negative results.

MALLEIN TEST.

Six horses and twelve mules were tested. No reactions.

IMPORTATIONS.

From the United Kingdom.—Horses 1.

From the Union of South Africa.—Mules 12, bulls 4, sheep 1,391.

From the Bechuanaland Protectorate.—Sheep 538.

EXPORTATIONS.

To the Union of South Africa.—Oxen 302, cows 12.

To Northern Rhodesia.—Horses 5.

To Portuguese East Africa.—Oxen 56, cows 40.

EXPORTATIONS.—MISCELLANEOUS.

To the United Kingdom in Cold Storage.—Chilled beef quarters, 2,559; frozen boned beef quarters, 1,781; kidneys, 218 lbs.; tongues, 3,440 lbs.; livers, 5,323 lbs.; hearts, 298 lbs.; tails, 749 lbs.; skirts, 1,375 lbs.; shanks, 4,008 lbs.

To Northern Rhodesia in Cold Storage.—Beef, 137,372 lbs.; pork carcases 57.

To the Belgian Congo in Cold Storage.—Beef 53,723 lbs.; pigs, 50.

Meat Products.—From Liebig's Factory.—Corned beef, 106,518 lbs.; beef fat, 45,000 lbs.; tongues, 3,600 lbs.

G. C. HOOPER SHARPE,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-38.

Monthly Report No. 62. January, 1938.

During January swarms of the Red Locust (*Nomadacris septemfasciata*, Serv.) have been present in various parts of the Colony, and egg-laying has been reported in the following districts, namely:—Sebungwe, Lomagundi, Darwin, Mazoe, Mrewa, Mtoko, Hartley and Gwanda.

Egg-laying is reported to have been fairly general on farms in the Concession section of the Mazoe District and also in parts of the Urungwe section of the Lomagundi District, but elsewhere on the higher veld the deposits appear to be scattered and more or less isolated.

Considerable breeding appears, however, to be taking place in the low veld of the Zambesi Valley in the Darwin and Lomagundi Districts, where hoppers have already appeared.

Birds have been reported as active in pursuit of the swarms, and one sample of locusts infested with maggots has been received. There is as yet no sign of *Empusa*.

Serious damage to young maize has occurred on several farms.

No general outbreak of hoppers is to be anticipated, but locally serious hatchings are liable to occur.

RUPERT W. JACK,
Chief Entomologist.

Maize grown on sandveld at Bimi, Macheke.

THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.
(Assisted by the Staff of the Agricultural Department).

PUBLISHED MONTHLY.

Subscription: 5/- per annum; payable to the Accountant, Department of Agriculture, Salisbury.

VOL. XXXV.] APRIL, 1938. [No. 4

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Sandveld Maize.—The frontispiece in this number was kindly supplied by Major J. C. V. Roos, of Evelyn Farm, Gadzema. The maize shown was grown on sandveld on Bimi, Macheke, and the photograph was taken in November. In submitting the photograph Major Roos states that it demonstrates that maize can be grown on sandveld provided the land is suitably fertilised. The tallest plant measured 14 feet 7 inches.

Magnesium—A Plant Food.—Magnesium is one of the "ten essential elements" of plant nutrition required in fairly large amounts for normal plant growth. It is not required by the plant in such large quantities as potassium or calcium, nor is it usually as important as phosphorus or nitrogen, but in

certain specific amounts it is absolutely essential. The general antagonistic effects between Ca and K, and between Mg and K in plants and soil systems are well known, but much work is still being done on the subject.

MacIntire and co-workers in Tennessee have published results of an eighteen-year lysimeter experiment on the subject, in which they measured the effects of twelve-year residues of lime and magnesia upon the outgo of subsequent additions of potash. Since they were not working on a crop basis, but were confining their efforts to soil effects only, they were able to experiment over a very wide range of concentrations. In brief, their conclusions are that applications of lime in all quantities, and "economic" additions of magnesia, have an extremely marked tendency to fix the native potash of the soil in an insoluble form, and also a tendency to fix subsequent additions of K_2O as fertiliser, the effect continuing for as long as six years after the liming has ceased. When an extremely heavy application of magnesia is made (32 tons per acre) then the potash does become definitely soluble, but this, of course, is a quite impracticable crop situation, being far past the lower limit of magnesium toxicity. And so, although applications of magnesia tend to repress losses of potash from the soil by leaching, the immediate effect of even small applications is a repression of the intake of potash by the tobacco plant, particularly at low levels of soluble soil potash.

Consistent with good quality, the probable optimum quantity of MgO for tobacco leaf, fluctuates between 1.8 and 2.5% of the dry matter, depending on the type of tobacco. Most native tobacco soils appear to be sufficiently rich in MgO to adequately supply this need. It seems, however, that some are not. Therefore, in certain localities it would be advisable, after diagnosis of plant growth or an analysis of the soil, to correct any deficiency that might exist. Only relatively small applications are required for this purpose, and care must be exercised in order to avoid disturbing any important potash relations in the soil, by large applications, or by consistent yearly applications of MgO when one or two might be sufficient.

In tobacco the burning quality is directly proportional to the percentage of K_2O. If, due to the antagonism between K_2O and MgO, the MgO of the soil tends to repress the solubility of K_2O and the amount absorbed by the plant, then it follows as a direct corollary that applications of MgO will lower the burning quality of tobacco. This theory has been substantiated by burn tests made at the Central Experimental Farm, Ottawa, and the Connecticut Agricultural Experiment Station.

So it may be seen that in attempting to correct one undesirable condition, the treatment used may induce another undesirable condition which may possibly be worse than the first. Thus the problem calls for a very fine discrimination of judgment in order that a properly balanced ration may be found.—G. M. Ward (from *The Lighter.*)

Granadilla Juice.—Passion fruit juice was prepared from fresh fruit and packed in three different types of cans, plain open-top cans, lacquered open-top cans, and wax-lined beverage cans. A number of glass bottles were also packed as controls. To one portion of the juice, sugar was added to give a cordial of density 45° Brix, and a similar series of tests was carried out on this product. The full range of tests was as listed in the following table:—

(*a*) *Unsweetened Juice.*

Containing no preservative but pasteurised 20 minutes at 170° F.

(1) Open-top cans—plain.
(2) Open-top cans—lacquered.
(3) Bottles.

(*b*) *Unsweetened Juice.*

Not pasteurised but containing benzoic acid as preservative.

(1) Wax-lined cans.
(2) Bottles.

(*c*) *Sweetened Juice.*

As tests (*a*).

(*d*) *Sweetened Juice.*

As tests (*b*).

The cans and bottles were examined after three months' storage at ordinary temperature during the autumn months, with the following results.

The product obtained in open-top cans was perfectly satisfactory. There was practically no difference between any of the containers, so far as colour and viscosity were concerned. The flavour of juice and cordial packed in lacquered cans was not quite so good as that from the plain cans, though the difference was so slight as to be apparent only when two samples were being tested side by side. The condition of the containers was quite satisfactory and no excessive corrosion was noted.

The juice and cordial preserved with benzoic acid differed quite considerably in appearance from that which had been sterilised by heat. Three samples out of four examined had separated into two layers, a clear pale yellow liquid and a thick brownish-yellow sediment. On shaking, the material could be mixed to a liquid resembling the fresh juice in colour and appearance, but much less viscous, *i.e.*, more watery in texture. Apart from this defect the colour was satisfactory and the flavour quite good, though a slight off-flavour due to the preservative could just be detected.

On the results of this examination, the product packed in open-ended cans appears to be quite equal to the bottled product, and there is no advantage to be gained by using lacquered cans. With regard to the juice preserved with benzoic acid, it seems likely that the difference in viscosity between this and the sterilised product might be due to the fact that no heat treatment had been given to the material containing preservative. This point might be investigated with advantage, and it is also possible that the wax-lined cans might be used for juice or cordial containing no preservative, but given a pasteurisation at some temperature below 170° F. Such a product would remain good for a considerable time after a can had been opened as the extremely high acidity of this material renders it less susceptible to the attack of micro-organisms.—(Bulletin of the Imperial Institute.)

Silica Dust as an Insecticide.—Many substances used as inseticides are actual insect-poisons, but various non-poisonous materials in the form of very fine dust have also been tried at different times, their lethal effect being more of a physical nature. In a series of recent trials one of the most promising of these materials was a proprietary silica dust stated to consist of a pure quartz sand, ground to such a degree of fineness that the particles approach colloidal size, and to contain 98 per cent. of silica, with only very small quantities of aluminium, iron, calcium, and magnesium compounds ("Versuche zur Bekämpfung des Kornkäfers mit Staubmitteln" by B. Germar, *Z. Angew. Ent.*, 1936, 22, 603-630).

The practical trials were made with the granary weevil (*Calandra granaria*). It is believed that the fatal effect of the dust is due to a withdrawal of water from the tissues of the insect, owing to the large increase in body surface caused by the adherent dust. The effect of the dust is consequently dependent upon the fineness of the particles, and their power of adhering closely to the body of the insect, but the age of the insect is also a factor, the younger individuals being definitely more readily susceptible than the older. The temperature and the relative humidity of the atmosphere are also important.

The treated grain should contain 1 per cent. by weight of the dust, which is best applied in the autumn or at the end of the winter, and should, of course, be stored in a dry place. The dust is non-toxic, and is removed by the usual processes preceding milling.

The treatment is said to be effective with regard to the existing weevil population, in retarding oviposition and hence preventing reinfestation, and to be economically practicable from the point of view of cost and ease of application.—(Bulletin of the Imperial Institute.)

"Here's How."

By Major G. St. J. Orde Browne, O.B.E. (Mil.), late R.A.; published by East Africa, Ltd., 91, Great Tichfield Street, London, W.1; price 5s.

In the foreword the author states that "Here's How" is intended to present in handy form the information likely to be wanted by the novice or amateur who must rely on his or her own efforts. It is obvious from the contents that the novices or amateurs referred to are resident in East Africa or some other far away Colony or Dominion where conditions are different from those in England. In fact the wrapper indicates that it is a book of hints for the man "in the Blue"; and this is precisely what it is.

As would be expected the hints concern the laying out of land, with simple instructions how to survey; the building of a settler's home; the making of drifts across streams; the use of cement and stone; painting and colour-washing and numerous workshop hints.

But this is not all. Household hints; medical notes; travel notes and numerous other subjects are included. Sport and games are not overlooked; dimensions are given for cricket and football grounds, tennis court, hockey grounds, etc.

This is a book which can be recommended to our readers with every confidence that they will find it both interesting and useful.

C.K.B.

The Control of Veld Fires.

By The Division of Forestry.

The dry season is again rapidly approaching and it behoves all farmers to put in hand preparations against veld fires which annually account for enormous losses in grazing, timber and soil.

Fortunately recent legislation enables the cost of providing fireguards to be very appreciably reduced owing to the provision of Section 6 of the "Forest and Herbage Preservation Act, 1936," under which the owner or occupier of adjoining private land may be called upon to contribute half the labour or cost necessary to provide and maintain sufficient fireguards on the common boundaries. The Act provides that no fireguard is deemed sufficient unless it is at least thirty feet wide on each side of a common boundary.

Constructing Fireguards.—The most satisfactory method of constructing fireguards is to clear two paths or traces, about five feet wide and at least thirty feet apart to serve as guide lines for the purpose of burning the intervening strip. These paths may either be scoffled or ploughed in such a way as to leave no inflammable matter on them. On land where erosion need not be feared ploughing of the whole thirty feet strip may prove satisfactory, and in this case no burning will be necessary. In general a much wider strip than thrity feet is advisable, particularly in tall grassland and exposed areas.

To burn the intervening strip between the traces firing is commenced on the leeward side until a sufficient width is burned to undertake safe firing from the windward side. The draught caused by the two fires tends to draw them together and a safe burn is effected.

The fireguard should be divided into sections for burning and the length of the section burned in any one firing will depend on the number of labourers available. The labourers,

equipped with shovels or leafy branches with which to keep the fire under control, should be spaced at judicious intervals along the guide lines.

Firing is best undertaken in the late afternoon or at night. As each length of strip is burnt a guard should be detailed to extinguish any vegetation or wood left in a smouldering condition. Such danger points are best extinguished by piling earth on them.

The establishing of a network of internal fireguards is of the greatest importance in reducing the fire hazard on the farm. Frequently these can be maintained at little cost by joining up areas of arable land with short fireguards and by utilising roads and paths to the best advantage.

Windbreaks and shelter belts of evergreen trees, if judiciously placed, are also useful in minimising fire damage, by lessening the force of winds and by acting as spark arresters.

It must be remembered that no fireguard, unless of exceptional width, can be considered infallible against all fires. It should be regarded primarily as a useful line of defence on which to mobilise the labour gang to cope with approaching fires.

To achieve the greatest security against fires constant patrol by fire watchers should be maintained during the fire season, and labour gangs, particularly over week-ends, should always be available for fire fighting.

Patrol by Special Native Constables.—In connection with the important factor of patrol attention is drawn to the facilities provided by the Police in attesting reliable natives as Special Native Constables for the control of grass fires.

Full particulars of this arrangement can be obtained from any Police Station, but the conditions are briefly as follows. The farmer selects a suitable "boy" and applies to the Police on a special form for his attestation. The "boy" is paid at a rate previously stipulated by the farmer, who also provides him with rations. The "boy," who is provided with

a special armlet indicating his position as a Special Native Constable, can then be employed by the farmer to patrol boundaries and apprehend anyone lighting fires, snaring, hunting or trespassing.

The local Police Officer inspects the work of the native from time to time. Natives can only be employed in this capacity during the dry season and for a period limited to six months, after which the armlet is returned. The system is designed to instil keenness into the native so employed and to act as a deterrent to natives who might otherwise light fires illegally.

Small Cost of Fire Protection.—Many farmers unfortunately abstain from fire protection measures owing to their fear that it will cost too much. Some idea of the cost may be obtained from the operations of the Forestry Division in Matabeleland, where the cost per acre protected, including efficient and daily dry season patrols, has averaged .43 pence per annum over a period of eleven years.

As this includes the cost of clearing many miles of fire-lines through heavily forested country, the figure is not inapplicable to farms.

A simple calculation will confirm this. Assume a farm of 5 square miles, or 3,200 acres, and a cost for burning and scoffling fire traces of £1 per mile. The total length of the sides of the farm, if square, will be nine miles. The cost to the owner shared between himself and his neighbours will therefore be £4 10s. 0d., which is equivalent to approximately 0.38 pence per acre.

If a police boy is employed for the months of August to November at 15s. per month with orders to arrest honey hunters and trespassers and to report all fires in the vicinity, the cost (which in this case cannot be shared) will only be another £3, or 0.22 pence per acre.

If the losses normally caused by drought and lack of grazing are taken into consideration together with the damage to trees and the encouragement of wind and other erosion, this is indeed a small sum to pay by way of insurance.

Forest and Herbage Preservation Act.—Farmers are urged to acquaint themselves with the provisions of the "Forest and Herbage Preservation Act, 1936." These are fully explained in Bulletin No. 1018 entitled "Veld Fires," which may be obtained free of charge from the Division of Forestry. Insofar as fires are concerned the main points of the Act may be stated briefly as follows:—

i. It is an offence for any unauthorised person to set fire to vegetation not his own property, or to light any fire if by so doing the fire spreads to vegetation which is not his property.

ii. Before burning his own vegetation he must give reasonable notice to his neighbours that he intends to burn, at the same time stating the approximate time of burning.

iii. If a fire spreads to adjoining property in spite of reasonable care, and after notice has been given, the persons responsible for the fire is not liable under the Act for wilfully and negligently setting fire to property not his own, but he may still be liable for damages under civil law.

iv. A land owner wishing to protect his land may call in his neighbours to contribute one half of the cost or labour in constructing and maintaining fireguards on the common boundary. In the event of his neighbour's refusal the owner may construct the fireguards and recover half the cost from his neighbour.

v. A sufficient fireguard must be not less than 30 feet on either side of the common boundary.

vi. Fireguards, provided they are of sufficient width, may consist of belts of fire-resisting trees or trees so treated as to prove adequate as fire-breaks. Any disputes as to the sufficiency of a fire-break shall be submitted to the Minister of Agriculture and Lands, whose decision shall be final.

vii. The Act enjoins every person properly to extinguish fires kindled by him on the land of another and on roadsides, outspans and vacant land. Counter-firing is permitted when life, person or property are endangered by the approach of fire.

GRASS MOWERS.

By H. Beynon, from *The Farmer*, March 4th, 1938.

Mowers were until a few seasons ago the bane of most farmers' lives. They would either not cut at all or jamb every few yards if they did cut. The machine made such a terrific noise that hay making and mowing time was a season to be dreaded. The new, oil-bath, totally enclosed gear machines have changed this to a very large extent, but many of the old type mowers are still good for many more years. Many years of struggling with second-hand mowers yielded tips which may or may not be worth while passing on. Here they are:—

Starting with the cutterbar; in my opinion the lower knife or ledger plates are about the most important parts of the cutting mechanism. Nearly all bad cutting can be traced to the fact that ledger plates are rounded and blunt. My advice is, replace ledger plates every season; it's worth it.

Next see that all the fingers are in line. One finger out of line can wreck a pitman. Most fingers are made of malleable iron and can be hammered up and down, but do not hammer on the point and do not forget to tighten after hammerings.

Wearing plates are nearly always so worn that it pays to replace them. See to the two holding down plates at the inner end of the bar. If these are badly worn the knife head has an up and down movement which eventually breaks the knife. Apart from this it causes a lot of noise and vibration.

Finally, do not hammer down the clips too much. A little play for the knife is better than a tight fit.

Pitman and Head.—On most old type mowers the pitman head has a bolt through both metal portions. This when tightened grips the knife head. Too tight and you bend the pitman head. Too loose and you get play. This is the quickest way of wearing out the knife head.

If you lose or break the bolt do not put a square or round head bolt in and hope for the best, because it will always work loose. Take a round head bolt, place the head on the anvil and hammer it square till it fits the square hole. Put a lock-nut on, because the original was left-hand thread and the new is right. If you have the automatic clip type press the lever right down. If it is not it might come loose.

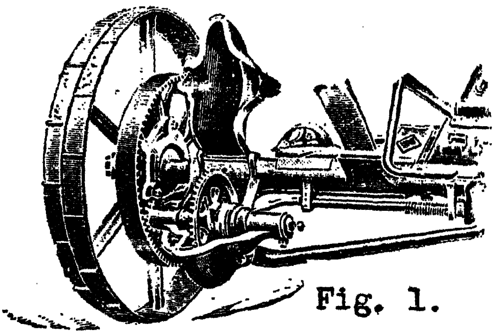


Fig. 1.

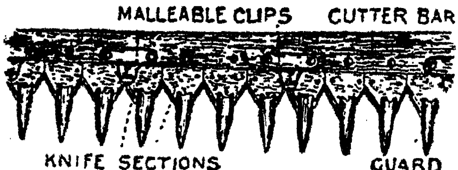


Fig. 2.

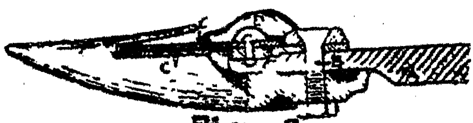


Fig. 3.

To keep the knife head oiled I always put wool in the oil hole. This keeps the oil in despite the movement.

Farmers usually make their own pitmans. Get it the right length so that the knives are registering exactly. Do not make rivets of six-inch nails as they always bend inside the wood and you have to stop to make another pitman.

If you have no rivets, use No. 6 wire, which has been softened.

Do not forget when you are drilling the holes that the bottom end holes usually run horizontal and the top ones at the pitman head bearing vertical. I have had to discard many a pitman through making this mistake.

Pitman Head Bearing.—If it is worn replace. It only costs 1s. 6d. or so and reduces noise and vibration. Some machines have a plain hole for oil. Fill this with wool and screw a short bolt in. Fasten the bolt to the pitman as it usually screws out and is lost. If you have a grease cap remove the grease in the bearing before the season's work and put new grease in. The old grease is usually hard and dry and will only ruin the bearing.

Some of the modern mowers have a proper oil ball cap. This is, in my opinion, much the best as oil cannot come out or dirt get in.

One of my troubles with regard to the pitman head was grass getting caught up between the flywheel and the frame. To stop this I fastened a piece of flat galvanised iron under the frame and up over the pitman head as a shield.

Transmission Shaft Bearings.—If there is play, especially in the rear bearing next to the pinion, it is better to replace as slipping of the pinion is usually caused by wear in this bearing.

Pinion.—When the pinion is worn, *i.e.*, the teeth have become sharp, replace. Otherwise you get slipping, possibly a broken bevel gear or pitman through the knife jamming.

Pawls.—On the older types of machines the pawls were nearly always in the wheels, so remove the wheels, clean the pawl cases and wash spring and pawls with paraffin. Do not lubricate.

Some of the modern machines still have this system. Some makers advocate greasing. This must therefore be done every season. Remove the large cap on the outside of the wheel, wash out all hard grease and put new grease in. See that the wheel is tight up against the casing and replace the pin or bolt.

Clutch.—This is usually in the form of three or four teeth on the drive shaft which engage in other teeth on the bevelled gear hub. See that they are cleared of much grease and grass

and that they fit right in. If they do not it may be caused by the automatic declutching device. This is a very frequent cause of trouble.

OIL BATH MOWERS.

All the points *re* cutter bar, pitman, bearings, etc., apply here, but one or two more tips may come in useful.

Pawls.—If you have pawls inside the gearbox there is hardly ever any necessity to examine them. They run in oil and no dust can get to them.

Pawls on the wheels, however, sometimes cause trouble, as in this case the wheel is loose on the axle and wear has to be taken up and new grease put in. Take up as much play as possible with the pin and adjuster at the end. It is difficult to eliminate all play, however, as the wheel being loose on the shaft becomes worn. Where the pawls are in the oil bath gear case of course the wheels are keyed to the shaft.

Bevel Gear and Pinion.—On some mowers any wear on the pinion can be taken up by adjusting an outside screw without opening the case at all. Adjust the depth so that there is the minimum of play and noise, especially noise, as this indicates too deep a setting; with this method the oil need not be drained.

Other mowers have internal adjustments. Remove cover to gear case, being careful not to break the gasket. Adjust and replace. Refill with oil.

Lift.—Adjust the mower to declutch at the proper time. If it declutches too soon the grass jams in the knife. If too late you may break a pitman.

Some mowers have combined high, vertical and plain lift, *i.e.*, by shifting a small lever you can have either one or the other type of lift. The high vertical lift enables you to lift the knife head clear over large stones in the field. Do not forget which lift is in operation.

Storage.—When you put the mower away for the winter buy a couple of labels. Note what is wrong with the mower and tie on to the lift lever. Next season you will know what spares to get without racking your brains as to what had given you so much trouble last season.

Operation.—Always use light oil. Oil bath mowers use S.A.E. 30-40, A.F. or B.B. Light oil on the cutter bar every hour or so is better than heavy oil or grease, as there is so much grit flying about. The same applies to the pitman head bearing.

Some machines have a hollow space in the bearing which allows you to work all day on one or two oilings. Grease or heavy oil collects dirt and sand and tends to wear the bearing quickly.

Always have the machine in gear when you start and lift the cutter bar slightly, allowing it to drop down after a few feet.

Height of cut: The extra inch you gain by cutting at ground level does not compensate for broken knives and cutter bars. Adjust your cut at about four inches.

Raise your knife slightly at corners.

TRACTOR MOWERS.

These are usually designed to work from a power take off, *i.e.*, direct from the engine. They cut anything from three to four times as much as an ox mower so are correspondingly more strongly built.

Attaching.—Usually attached by one bolt to the draw bar. Do not tighten this bolt up solid as this makes it difficult to fit the mower in position. Tighten until the coils of the spring on the bolt are 1-16 or so apart. Do not tighten up the springs on the safety device until you know the mower's capabilities.

If it has a poor take off examine the oil level of the mower gear chamber every day.

These mowers usually cut very low, so turn the blade up as high as possible to prevent it catching in the ground. No harm can come of catching in the ground, but it means stopping and refitting the mower, as the safety device comes into operation and pulls the mower out of gear. Adjust the float spring so that the mower rides over the ground and does not drag.

The Maize Weevil Problem.

Letter from Mr. J. C. Howard, Sheepridge Farm, Zawi.

"I have read with interest Mr. Mossop's article on weevil infestation in your December issue. I hope you will not mind if I offer a few comments on it and believe it is an honest endeavour on my part. to offer a little constructive criticism. I have Mr. Mossop's article before me now and with your permission will comment on the various paragraphs as I go along. My comments, of course, apply only to my observations on my own and neighbouring farms. The first paragraph refers to newly delivered maize being graded slightly weevily. Now, Sir, how often is maize graded immediately on delivery? My experience has been that maize lies at the sidings at least three or four weeks before being graded, ample time for it to become infested from station buildings and maize sheds, also dunnage from the previous year. Even to-day there is any amount of old dunnage lying at Zawi, not having been properly burned. It is also impossible to get 100 per cent. efficiency in fumigating the old maize sheds, some weevil are bound to escape. Furthermore, very often new maize is delivered before the sheds have been cleared of the old weevily maize, and when loading takes place the new maize is bound to become infested. What more prolific source of infestation can there be than from old maize sheds and station buildings? You mention field infestation as playing a large part in the infestation of dumps and store rooms. In this district field infestation is practically non-existent, and even if it were present I don't think one weevil in a million would find its way safely through the blowers and sieves of a power sheller into the bags. To my mind Mr. Mossop has missed the main cause of dump infestation, and that is the use of old infested bags at the dump. Every farmer when shelling uses several hundred second-hand bags, which are usually heavily infested. These bags have spent the whole year in his store and are then taken down to the dump to be

used for broken grain, meal reserves, etc., and to my mind this is the cause of fresh maize being delivered weevily and field infestation wrongly blamed. On occasions, when waiting for the sheller after reaping, the new bags are put away into the store rooms for safety and become infested. Personally, I never put new bags in my store rooms, and any old bags I use at the sheller are left to lie out in the sun for weeks and then thoroughly shaken inside and out before being taken to the dump. I have been growing maize for eighteen years and have never yet been graded weevily. To sum up, new maize being graded slightly weevily is caused by the use of already infested bags, or infestation from station buildings and maize sheds at the stations. I trust you will accept the foregoing letter in the spirit in which it is intended."

Reply from M. C. Mossop, M.Sc., Entomologist.

"Many thanks for your letter of 31st January, addressed to the Editor of the *Journal*. Constructive criticism of this nature is always appreciated. There appear to be some points in my article, "An Unusual Winter Outbreak of Maize Weevil," that, through insufficient explanation, may lead to misapprehension.

As its title indicates, the article was an attempt to explain the outbreak of weevil during the winter months, and not a discussion of the various sources of infestation of maize. The opening paragraphs, however, suggested my view of the main events which lead to infestation of new maize, and this is based on three years' surveys in the field, though necessarily in a limited area.

I most readily agree that maize weevil is carried from store rooms to the fields in second-hand and even on new bags. The position is inclined to be exaggerated, because many farmers mistake the flat brown flour-beetle for weevil. Flour-beetles are carried in second-hand bags in much greater numbers than are true weevils, and they are far more persistent. The transport of maize weevil on bags to the lands at harvesting time, of course, adds somewhat to the number of adults brought in from the field to the dump, for only adult

weevils are carried on empty bags and, as you say, many of them get blown out during threshing. A percentage of these (probably a small percentage) will find their way back to the bagged grain. Many more will get into the shelling dump, and where conditions are favourable, their progeny will add to the following year's field infestation.

Field infestation, however, does not involve only adult weevils. The adults get into the field chiefly by flying and crawling from store rooms and shelling dumps, but also to a lesser degree by being transported there by various means and from various sources. It is possible, also, that weevil may actually persist in the field from season to season, but I have, as yet, no data in this respect. The point is that some adults are in the field from the time when the maize is in the dough stage, and possibly earlier. These give rise to the breeding of weevil in the grain on the cob while the plants are still standing. The position at harvesting, therefore, is a mixed infestation of adults, eggs, grubs, and pupæ. The eggs, grubs, and pupæ are all *inside the grain,* and no amount of blowing in shellers will dislodge them, unless it is so fierce that the grain is broken. The infestation taken over the whole field may be quite light, but on the portion nearest the dumps and store rooms it is often fairly heavy. Near large stores such as railheads, the infestation is commonly severe.

My main objects at present are to find a means of reducing infestation in the stacks at railhead, and to find a means of breaking the cycle which consists of field weevils infesting store and dumps and *vice versa.*

My reference to maize arriving infested from the farm was deliberately worded as follows: "When maize, newly arrived from the farm, is graded as ' slightly weevily,' there can be no doubt that, with very few possible exceptions, the infestation has come from the farm." This was merely to introduce the subject of field infestation and was certainly not intended to convey the impression that *all* grain is inspected on arrival. I hope I did not fail in my object in this respect. I have seen maize at stations or sidings that

has obviously become infested while awaiting acceptance—the sheds were not ready, or the maize was not sufficiently dry, or a grader was not available on the spot. (Incidentally, I have had no acceptable evidence that such maize was not previously slightly infested.) Delays of this kind arise from marketing conditions, non-availability of transport, and the financial necessity for the restriction of the size of the grading staff. The Maize Control Board, while admitting the difficulty, is anxious to overcome it.

The matter of (presumably) infested dunnage, will be referred to the Maize Control Board.

May I close by asking a favour of you? The simplest method of discovering field infestation that I have found is to examine during May or June, or later if the crop is still standing, a number of cobs, say, not less than 25, that have tips or other portions that are exposed and show evidence of having been exposed for a few weeks. The actual grain need not be exposed, provided that there has been a suitable entrance for weevil. Such examination should be made at the nearest point in the land to a likely source of infestation such as a shelling dump or store room in which maize has recently been stored. Native compounds are often a source of infestation. In a poor crop, weevil is more difficult to find than in a good crop.

I should be much obliged if you would make such an examination, and get your neighbours and other friends sufficiently interested to do the same. Whether you find weevil or not, I should be glad to know the result, together with information regarding the amount of maize stored and how and when stored, the treatment given to shelling dumps, and the distance from store or dump to the portion of land examined. Such information will be of considerable help."

The Chairman of the Maize Control Board has supplied the following additional information :—

"1. It is correct that maize sometimes lies at sidings for some weeks before being graded by the Government Grader. When, however, farmers require receipts, it can always be

arranged for the Board's Checker to take over the maize and classify it before the Government grading takes place. The producer is paid on the basis of his receipt.

2. Dunnage.—The Railways take responsibility for burning dunnage at stations and sidings which are not depots; at other places the Board's Checkers are responsible. Detailed instructions in regard to the work are repeatedly issued by the Board.

3. It is almost impossible to eradicate weevil entirely from the sheds. Endeavours are made every year to reduce the infection in every way possible; the methods followed are those advised by the Department of Agriculture."

Nitrification in Red Soils
IN THE SALISBURY AREA.

By A. P. Taylor, M.A., B.Sc., and B. S. Ellis, B.Sc., A.I.C., D.I.C., Agricultural Chemists.

The object of the experiments described and discussed in this paper was to investigate the relative rates of nitrification of bloodmeal and sulphate of ammonia in a normal Rhodesian red loam.

The question is of particular interest, as bloodmeal is a common constituent of tobacco fertiliser, and is generally applied in the belief that it is the main source of nitrogen for the tobacco plants during the latter part of the growing season.

The theory has also been advanced that in unfavourable growing seasons as, for example, when drought periods occur followed by a rainy spell, the use of bloodmeal may render the plants susceptible to certain diseases. The reason adduced for this is that the supposed slow rate of nitrification of the bloodmeal results in too much nitrate being present in the soil late in the season; this delays ripening and encourages secondary growth in the tobacco plants.

Description of Experiments.—The soil used in these experiments was the red dolerite loam from the Salisbury Experiment Station, which is slightly acid to reaction, with a pH of 6.4 to 6.7.

1. A composite sample from a non-green-manured plot was collected on 14th February, 1934. The bulk sample was sieved through a 2 m.m. sieve and six portions were weighed out into 250 c.c. glass beakers. Two of these were kept for controls, two for the determination of the rate of nitrification of the added ammonium sulphate, and two for that of the added bloodmeal. Ammonium sulphate and bloodmeal, previously analysed for nitrogen content, were added in quantities which ensured that the same amount of actual nitrogen was supplied

per 1,000 gms. of soil. Actually .522 g. and .516 g. nitrogen per 1,000 gms. soil were added respectively to bloodmeal and sulphate of ammonia beakers. The soils were carefully mixed with the added nitrogenous compounds, and all samples, moistened with distilled water, were placed in an incubator at 35° C. They remained there for a period of one month, their moisture content being kept approximately constant by the addition of small amounts of water at intervals.

At the end of the month the soils were removed and analysed for nitrate content; the figures, expressed as percentages of the original amounts of nitrogen added, and due allowance having been made for the nitrate in the control soil, were 24.8% for bloodmeal and 18.0% for sulphate of ammonia.

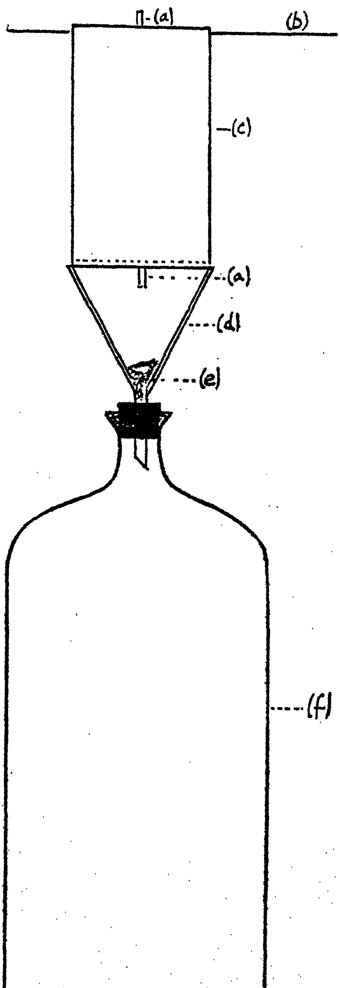
2. The whole experiment was repeated during the succeeding month, and the figures obtained for nitrate content were 34.9% for bloodmeal and 14.0% for sulphate of ammonia.

These results were considered to be of sufficient interest and importance to warrant further confirmatory trials under more natural conditions than incubation, so the experiment detailed below was laid down for the season 1934-35.

3. Soil from the same area as before was sampled on 21st November, 1934, and, when dry, sieved through a 2 m.m. sieve and the bulk sample thoroughly mixed. Bloodmeal and sulphate of ammonia were added in quantities such that 1,000 gms. of soil contained .5 gm. of nitrogen. The thoroughly mixed material was now packed down in a condition as closely as possible resembling its natural state in a coffee tin with a piece of canvas over the perforated base, so that liquid only, and not soil particles, could escape.

A miniature lysimeter, consisting of a Winchester quart bottle fitted with a funnel, the stem of which passed through a tightly fitting rubber cork in its neck, was improvised. The outside diameter of the funnel was equal to the diameter of the perforated base of the coffee tin. Three to four drops of toluene to prevent nitrification inside were inserted in the bottle before it was placed in its permanent position.

Holes were sunk in the ground, on a small plot on the Experiment Station, and their depths arranged so that the top of the tin, which rested firmly on the top of the funnel, was level with the ground surface. To prevent air-choking, a thin glass tube was passed through the soil in the tin, its lower end projecting about one-half inch below the bottom of the tin into the funnel. The whole system was as illustrated.



(a) Glass tube. (b) Ground level. (c) Coffee tin. (d) Funnel. (e) Glass wool. (f) Winchester quart bottle.

In all, eighteen of these miniature systems were installed, the experiment being done in duplicate throughout. Two systems for bloodmeal, sulphate of ammonia, and control, respectively, were removed at the end of three consecutive months, and estimations of nitrate content made in soils and drainage waters. The method of analysis employed was that of C. Olsen(1). The results, a summation of the nitrate figures from soils and drainage waters, control figures having been subtracted, were as follows:—

	Percentages of added nitrogen nitrified.	
	Bloodmeal.	Sulphate of Ammonia.
After 1 month	20.7	11.3
After 2 months	51.1	31.4
After 3 months	54.5	62.5

4. Owing to circumstances outside our control, full figures are not available for season 1935-36, although it may be mentioned that so far as they go, the results were similar, but in 1936-37 the same experiments were again instituted, this time extending over a period of six months from November, 1936. The procedure was exactly the same as that described above for 1934-35. The results were as follows:—

	Percentages of added nitrogen nitrified.	
	Bloodmeal.	Sulphate of Ammonia.
After 1 month	44.0	22.5
After 2 months	49.7	39.6
After 3 months	57.2	56.0
After 4 months	35.8	75.2
After 5 month	24.8	71.0
After 6 months	13.7	29.8

These figures, while confirming our previous results for the first three months, introduced another problem, in that the nitrate nitrogen percentages recovered were progressively lower in the bloodmeal tins from the third month onwards, and in the sulphate of ammonia tins from the fourth month. It was recognised that this was entirely owing to denitrification taking place in the experimental tins, which on several

occasions during the heavy rain storms of late February and March had become waterlogged, so allowing denitrifying bacteria to function.

Waksman[2] states, "In solution and in the presence of the proper organic substances, the bacteria may liberate practically all the nitrogen present in the nitrate form as free nitrogen gas, while in moderately moist soil, only protein may be formed out of the nitrate. But if the soil is very moist and nitrates are present, denitrifying bacteria behave as in solution and liberate considerable quantities of free nitrogen gas."

5. In order, therefore, to test out the behaviour of these soils when there was no possibility of waterlogged conditions arising, a final set of experiments was arranged for the season 1937-38. Thirty-six beakers, each containing 250 gms. of soil were utilised, 12 for bloodmeal, *i.e.*, two for each month up to six months, 12 for sulphate of ammonia, and 12 for control. The soil was found to contain 2.0% moisture, and 125 mgms. of nitrogen in the form of bloodmeal and sulphate of ammonia were added to each beaker of their respective sets, which amounted to the old figure of .5 gms. per 1,000 gms. of soil, or 0.51 gms. in 1,000 gms. of dry soil. The beakers were maintained under controlled conditions at a temperature of approximately 27° C., kept moist by adding 25 c.c. of distilled water every fourteen days, and two from each set removed for analysis at the end of each month.

The results, calculated on a dry soil basis, as in previous years, and allowing for control, were as follows:—

	Percentages of added nitrogen nitrified.	
	Bloodmeal.	Sulphate of Ammonia.
After 1 month	57.4	29.9
After 2 months	71.9	56.1
After 3 months	76.0	69.8
After 4 months	74.3	77.2
After 5 months	76.7	90.0
After 6 months	80.5	97.3

These results bear out the theory that the diminution in nitrate content in the later months during the outside experiments of the preceding year, was due to denitrification following waterlogging, and also once more confirm the results obtained each preceding year for the first three months. The depression to 74.3 in the fourth month for bloodmeal cannot be accounted for, but is of no practical importance.

Discussion of Results.—The most striking and most important feature emerging from the results of these experiments is the rapid nitrification of the bloodmeal nitrogen during the first three months as compared with that of the ammoniacal nitrogen. This feature has been consistent throughout and disposes of the theory—for these slightly acid red soils, at all events—that plants when fertilised with a mixture of ammoniacal and bloodmeal nitrogen are dependent upon the nitrates emanating from the ammoniacal constituent until the bloodmeal has had the requisite time to nitrify. Since we commenced these experiments, independent workers, Brioux and Jouis[3], working from a slightly different standpoint, have published results showing that in decalcified silty soils, dried blood nitrified better than sulphate of ammonia when the soils were slightly acid, or acid, while the reverse held for neutral or alkaline soils. Their figures were, for soils with a pH of 6.0:—

	Percentages of added nitrogen nitrified.	
	Dried Blood.	Sulphate of Ammonia.
After 15 days...	11.1	4.2
After 1 month	47.9	30.8
After 3 months	81.2	66.2
With a soil of pH 6.5, the figures were:—		
After 15 days	19.2	13.4
After 1 month	50.7	44.8
After 3 months	65.4	77.2

These figures bear out our results very strikingly. The pH of the soils we worked with varied from 6.4 to 6.7, and our comparative figures for the two sources of nitrates are strictly in line.

Brioux and Jouis do not publish figures for a greater period than three months. In all our experiments, however, even in those left incomplete in 1935-36, we found that after the third month, in 1934-35 just *at* the third month, the percentage of nitrates from the sulphate of ammonia exceeded that obtained from the bloodmeal, and remained higher as long as the experiment continued, even under the denitrifying conditions obtaining in 1936-37. This is particularly exemplified in the final experiment of 1937-38, which, as explained, was carried out under laboratory controlled conditions. We consider that in well-drained lands, it is unlikely that waterlogged conditions will normally occur, and feel justified in assuming that nitrification will proceed more or less comparably with our final figures.

Conclusions.—On normal, slightly acid, red loams, such as those on the Salisbury Experiment Station, bloodmeal nitrogen is, for the first three months of the growing season, converted more rapidly to nitrate nitrogen than is ammoniacal nitrogen from sulphate of ammonia.

At the end of three months, the amount of nitrified nitrogen from sulphate of ammonia is approximately equal to that from the bloodmeal, and thereafter the nitrification proceeds more rapidly with the former, the whole being almost completely nitrified in six months as against 80% of the bloodmeal nitrogen.

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(2) Principles of Soil Microbiology. Waksman, p. 551.

(3) Brioux, C.; Jouis, E.: Nitrification in silty soils of plateaux. Ann. Agron. 5, 1935 (622-631).

Acknowledgments are made to—

Mr. A. D. Husband, Chief Chemist, for kindly suggestions and criticisms.

Dr. J. C. F. Hopkins, Senior Plant Pathologist, and

Mr. L. E. W. Bevan, Beit Research Worker, for use of incubators.

Mr. H. C. Arnold, Manager of Salisbury Experiment Station, for use of part of the Station and assistance with labour.

TOBACCO EELWORM,

(*HETERODERA MARIONI*).

REPORT ON FARMERS' REPLIES TO QUESTIONNAIRE.

By J. C. Collins, B.Sc., Assistant Tobacco Officer.

Early in August, 1937, the Department of Agriculture, in response to a request made by the Council of the Rhodesia Tobacco Association, submitted a questionnaire to 443 tobacco growers in the Colony, in order to ascertain as far as possible the exact position regarding the serious problem of eelworm infestation.

There was considerable lack of enthusiasm on the part of growers in replying to this questionnaire, so much so that by the 24th January, 1938, only 153 replies had been received (approximately $33\frac{1}{3}\%$ of those solicited). As it was apparent that there would be no further replies forthcoming these 153 were forwarded to this office for attention.

The following is a report on information extracted from such replies:—

On 118 farms eelworm infestation is apparent to a lesser or greater extent, while on the remaining 35 there is no evidence of this pest. Infestation is general throughout the tobacco growing areas of Southern Rhodesia, and is not confined to any particular districts, but unfortunately owing to two-thirds of the growers not having replied, it is not possible to state definitely which districts are most severely affected.

Analyses of the 153 replies received show that:—

	No. of farms infested.	No. of farms free from infestation.
in the Lomagundi District	30	10
,, Mazoe District	26	8
,, Salisbury District	12	2
,, Hartley District	8	2
,, Marandellas District	14	5
,, Makoni District	21	3
,, Mrewa District	1	1
,, Melsetter District	1	0
Replies showing no address	5	4
	118	35

For a more detailed survey of infestation, based on the replies received, Table 1 should be consulted. In this table are shown what areas are included within a particular district and also what percentage of cultivated lands is estimated to be infested.

It will be seen from the following table that 118 growers report the presence of eelworm on their farms, while 35 growers report that their farms are free from eelworm infestation.

Of the 118 infested farms—

in 37	cases	1- 5%	of the total cultivated land is infested
,, 14	,,	6-10%	,, ,, ,, ,,
,, 21	,,	11-20%	,, ,, ,, ,,
,, 26	,,	21-30%	,, ,, ,, ,,
,, 5	,,	31-40%	,, ,, ,, ,,
,, 4	,,	41-50%	,, ,, ,, ,,
,, 2	,,	51-60%	,, ,, ,, ,,
,, 2	,,	61-75%	,, ,, ,, ,,
,, 7	,,	76-100%	,, ,, ,, ,,

These figures show that on eleven farms more than 50 per cent. of the total cultivated land is infested with nematode. In one particular instance the intensity of infestation is so severe that the owner states that he has been driven out of business owing to it being impossible to produce a remunerative crop.

District.	No. of farms infested.	No. of farms not infested.	No infestation.	1-5% total cultivated land.	6-10% O.T.C. land.	11-20% O.T.C. land.	21-30% O.T.C. land	31-40% O.T.C. land.	41-50% O.T.C. land.	51-60% O.T.C. land.	61-75% O.T.C. land.	76-100% O.T.C. land.
			No. of farms with cultivated lands infested to the extent of:—									
1. *Lomagundi*—												
(*a*) Darwendale area	3	0	0	0	2	0	0	1	0	0	0	0
(*b*) Maryland area	3	0	0	1	0	0	0	0	1	0	0	1
(*c*) Trelawney area...	11	4	4	5	1	0	3	0	0	1	0	1
(*d*) Banket area...	8	5	5	6	2	0	0	0	0	0	0	0
(*e*) Eldorado area	4	1	1	2	0	0	2	0	0	0	0	0
(*f*) Sinoia area	1	0	0	1	0	0	0	0	0	0	0	0
	30	10	10	15	5	0	5	1	1	1	0	2
	40						40					

Note.—O.T.C. Land=of total cultivated land.

District.	No. of farms infested.	No. of farms not infested.	No infestation.	1-5% total cultivated land.	6-10% O.T.C. land.	11-20% O.T.C. land.	21-30% O.T.C. land	31-40% O.T.C. land.	41-50% O.T.C. land.	51-60% O.T.C. land.	61-75% O.T.C. land.	76-100% O.T.C. land.
2. *Mazoe*—												
(*a*) Shamva area	2	0	0	0	0	1	0	0	0	0	1	0
(*b*) Bindura area	2	2	2	1	0	0	0	1	0	0	0	0
(*c*) Glendale area	1	0	0	1	0	0	0	0	0	0	0	0
(*d*) Concession area	6	2	2	2	0	1	1	0	1	1	0	0
(*e*) Msonneddi area	6	3	3	3	1	0	2	0	0	0	0	0
(*f*) Umvukwes area	7	0	0	4	0	3	0	0	0	0	0	0
(*g*) Mazoe area...	2	1	1	1	0	0	1	0	0	0	0	0
	26	8	8	12	1	5	4	1	1	1	1	0
	34						34					

TABLE 1.—(*Continued.*)

District.	No. of farms infested.	No. of farms not infested.	No infestation.	1-5% total cultivated land.	6-10% O.T.C. land.	11-20% O.T.C. land.	21-30% O.T.C. land.	31-40% O.T.C. land.	41-50% O.T.C. land.	51-60% O.T.C. land.	61-75% O.T.C. land.	76-100% O.T.C. land.
			No. of farms with cultivated lands infested to the extent of:—									
3. *Salisbury*—												
(*a*) South area	4	0	0	1	0	2	1	0	0	0	0	0
East area	6	1	1	0	3	1	2	0	0	0	0	0
West area	2	1	1	0	0	1	0	1	0	0	0	0
	12	2	2	1	3	4	3	1	0	0	0	0
	14						14					
4. *Hartley*	8	2	2	2	0	3	0	0	1	0	0	2
	10						10					
5. *Marandellas*—												
(*a*) Marandellas & Wedza areas	12	2	2	3	1	3	5	0	0	0	0	0
(*b*) Macheke area	2	3	3	0	0	0	2	0	0	0	0	0
	14	5	5	3	1	3	7	0	0	0	0	0
	19						19					

No. of farms with cultivated lands infested to the extent of:—

TABLE 1.—(*Continued.*)

District.	No. of farms infested.	No. of farms not infested.	No. of farms with cultivated lands infested to the extent of:— No infestation.	1-5% total cultivated land.	6-10% O.T.C. land.	11-20% O.T.C. land.	21-30% O.T.C. land.	31-40% O.T.C. land.	41-50% O.T.C. land.	51-60% O.T.C. land.	61-75% O.T.C. land.	76-100% O.T.C. land.
6. *Makoni*—												
(*a*) Headlands area...	2	1	1	0	1	0	1	0	0	0	0	0
(*b*) Rusape area	2	1	1	0	0	1	0	0	0	0	0	1
(*c*) Inyazura-Tsungwesi area	15	0	0	3	1	4	2	2	1	0	1	1
(*d*) Odzi-Achnashee area ...	2	1	1	0	1	1	0	0	0	0	0	0
	21	3	3	3	3	6	3	2	1	0	1	2
	24						24					
7. *Mrewa*	1	1	1	0	0	0	1	0	0	0	0	0
	2						2					
8. *Melsetter*—												
Chipinga area	1	0	0	0	0	0	0	0	0	0	0	1
	1						1					
9. *No Addresses given*	5	4	4	1	1	0	3	0	0	0	0	0
	9						9					

Although the infested cultivated land on fifty-one farms does not at present exceed ten per cent. of the total, it is a very serious problem indeed that the growers on these farms are called upon to face, for under suitable conditions the eelworm population increases at an alarming rate. This point is better appreciated when it is realised that it is possible where soil, host and temperature conditions are optional, to find as many as 1,200 eggs in a single egg-mass, and that further, parthenogenetic reproduction is quite normal and regular among *Heterodera marioni*.

Sixty-eight farmers state that infestation has definitely increased on their farms during recent years, while of the eighty-five others who have not noticed any sign of spread, it should be noted that a large number are referring to merely one or even two years experience of a particular farm, and that in such cases it would not be wise to place much reliance on their observations. A knowledge of the life history of this pest is sufficient evidence, that where control measures are not adopted, spread of infestation is inevitable.

Replies to questions 4 and 5 of the questionnaire required considerable alteration, for in many cases where persons stated that some of their tobacco lands had in the past been native gardens, in replying to question 5 they say that no crops other than tobacco have been grown on their lands. This is hardly conceivable, for wherever natives have their kraals they invariably grow crops such as maize, peanuts, kaffir beans (*Vigna catjang*), munga and sweet potatoes, etc., in addition to any tobacco they may produce.

The information extracted from corrected replies is tabulated below:—

A.

On 79 farms no evidence of previous native cultivation.

On 51 farms there is evidence of previous native cultivation.

On 18 farms the present European occupiers are in doubt as to whether or not natives cultivated the land in years gone by.

In 5 replies to the questionnaire this question is completely ignored.

Total 153 *replies.*

B.

68 farms on which infestation is apparent in lands which have grown other crops previous to tobacco.

48 farms on which infestation is apparent in tobacco lands have grown no other crops previous to tobacco on such lands.

11 farms which are free of infestation have grown no other crops previous to tobacco on their tobacco lands.

3 farms which are free of infestation have grown other crops previous to tobacco on their tobacco lands.

23 unsatisfactory replies. Either the question is completely ignored or else answered in an unintelligent manner.

Total 153 *replies.*

C.

On 9 nematode infested farms maize only was grown previous to tobacco and was grown solely by Europeans. No evidence of native cultivation.

On 48 nematode infested farms no other crops were grown previous to tobacco. No evidence of native cultivation.

On 48 nematode infested farms native crops* were grown previous to tobacco. Evidence of native cultivation.

On 11 nematode infested farms crops similar to native crops, such as maize, peanuts, kaffir beans, cowpeas, sweet potatoes and also potatoes, sunnhemp, sunflower, etc., were grown by Europeans previous to tobacco. No evidence of native cultivation.

On 3 nematode free farms native crops* were grown previous to tobacco. Evidence of native cultivation.

On 11 nematode free farms no other crops were grown previous to tobacco. No evidence of native cultivation.

23 unsatisfactory replies.

*The term "native crops" should be understood to include maize, kaffir beans, munga, peanuts, rapoko grain and sweet potatoes.

D.

On 48 nematode infested farms there is evidence of native cultivation in the past.

On 68 nematode infested farms there is *no* evidence of native cultivation in the past.

On 3 nematode free farms there is evidence of native cultivation in the past.

On 11 nematode free farms there is *no* evidence of native cultivation in the past.

From *D*, which is really a brief summary of *A*, *B* and *C*, it will be seen that native gardens are not *necessarily* a source of eelworm infestation as is commonly believed by many farmers, for out of 116 nematode-infested farms there is no evidence of previous native cultivation on 68 as against 48 on which there is.

By this deduction, however, it is not intended to infer that it is safe or advisable to grow tobacco on land which was previously cultivated by natives, as in many cases the pest may have been introduced to the native garden from indigenous weed hosts or some other source and have been allowed to thrive and multiply owing to lack of knowledge and initiative on the part of the native, and to the suitability of the crop plants, for kaffir beans, sweet potatoes, and in some cases maize and munga serve as hosts. Often the writer has observed the presence of *H. marioni* in weeds and crop plants in native gardens of both recent and distant date.

Replies to question 6: "Have you ever discovered eelworm in your seed-beds? If so, from what source was the water derived?" are tabulated below:—

(1) On 52 nematode infested farms eelworm have been reported to have been observed in the seed-beds:—

In 38 cases seed-bed water derived from rivers and streams.

In 3 cases seed-bed water derived from wells.

In 4 cases seed-bed water derived from pools in vleis.

In 1 case seed-bed water derived from river and borehole.

In 1 case seed-bed water derived from river, borehole and pools in vlei.

In 1 case seed-beed water derived from river and dam.

In 1 case seed-bed water derived from river and pools in vlei.

In 1 case seed-bed water derived from spring.*
In 2 cases seed-bed water derived from sources not mentioned in replies.

—
52

(2) On 62 nematode infested farms no eelworm have been observed in the seed-beds:—

In 12 cases seed-bed water derived from river.
In 2 cases seed-bed water derived from springs.
In 1 case seed-beed water derived from wells.
In 1 case seed-beed water derived from pools in vlei.
In 1 case seed-bed water derived from rivers and bore-holes.
In 1 case seed-bed water derived from rivers and springs.
In 44 cases seed-bed water derived from sources not mentioned in replies.

—
62

(3) On 35 nematode free farms (no eelworm observed in seed-beds or in lands):—

In 5 cases seed-bed water derived from rivers and streams.
In 2 cases seed-water derived from dams.
In 1 case seed-bed water derived from pools in vlei.
In 27 cases seed-bed water derived from sources not mentioned in replies.

—
35

(4) On 4 nematode infested farms the growers are in doubt as to whether or not eelworm were present in the seed-beds:—

In 1 case water derived from river.
In 1 case water derived from dam.
In 1 case water derived from river and dam.
In 1 case water derived from source not mentioned in reply.

—
4

*There is evidence that eelworm were introduced into the water through surface drainage from a severely infested field.

A summary of the above figures reads:—

On 52 nematode infested farms eelworm observed in seed-beds.

On 62 nematode infested farms eelworm *not* observed in seed-beds.

On 35 nematode free farms eelworm *not* observed in seed-beds.

On 4 nematode infested farms growers doubtful whether or not eelworm in seed-beds.

Too much importance should not be placed on the replies to this question (question No. 6) as to the layman's eye it would not be an easy matter to distinguish for certain the presence of *H. marioni* in tobacco seed-beds. Positive observations are only easily made when the plants have been left in the seed-beds long enough to reach a size of ten inches or more, or when the intensity of infestation is exceedingly severe. Neither of these conditions is very commonly met with.

In this connection, another point to bear in mind is that not every farmer is familiar with the galls produced by the tobacco root-knot nematode, therefore in many cases where the pest really was present in the seed-beds it might have been ignored, and *vice versa*.

It should also be realised that in some cases the seed-beds might quite reasonably have become infested through having been built on previously infested ground, *e.g.*, a diseased native garden, or through wash from some other infested area, and in such cases the water supply cannot be blamed.

That seed-bed water is one source of introduction of infestation has been proved by the writer in experiments conducted at the Trelawney Tobacco Research Station, but it is not the only source. Water is not the natural habitat of *H. marioni;* in fact, it is capable of being drowned in it, and so it stands to reason that it must be introduced into the water from elsewhere, *e.g.*, from indigenous weed hosts or from infested crop lands, including infested native gardens. The mediums whereby the pest could be introduced to the water are surface drainage and the feet of persons and animals.

This theory meets with the approval of a large proportion of the tobacco-growing community—as evidenced in replies to the questionnaire under review.

Before dealing with the answers relating to the remaining questions, it should be made clear that in the case of water derived from a spring (referred to in (1) and marked*) the water became polluted by eelworm through infestation being washed into it from an adjacent, more elevated and heavily infested potato field.

In replying to the second half of question 7, ". . . . have you any evidence of eelworm in virgin land?" 52 farmers assert that they have, but in at least five cases out of the 52 infestation is thought, by the persons concerned, to have been introduced to the virgin land by the use of plants which originally became diseased in the seed-beds.

Fifty growers with infested farms have not observed nematode in their virgin lands, and similarly 35 others on whose farms no eelworm is present. The remaining 16 growers have either entirely ignored this question or else submitted doubtful answers.

That eelworm are present in virgin land should be an undisputed fact. The writer has himself come across indigenous weeds (in virgin bush) harbouring the pest, and makes mention of this in his annual report as Tobacco Biologist for the year 1936-37.

In the questionnaire farmers are asked whether they have any definite ideas or proofs of the source of infestation. In 13 cases the water supply of seed-beds is thought to be the source, in 12 cases native gardens, and in two cases indigenous weeds.

In addition, 23 growers are convinced in their own minds that infestation commences in the seed-beds through using infested water; while two feel positive that old native gardens are to blame; two others assert that on their individual farms infestation has spread from infested potato lands, and another traces the source to being diseased antirrhinim beds in his flower garden. Two persons are emphatic that water-logging is the cause of infestation. In the remaining 96 cases the growers offer no suggestions.

To discuss the points raised in this connection: As has already been pointed out the water supply of seed-beds is often to blame, and so may native gardens, provided eelworm are present in them. Potatoes are a recognised host of *H. marioni*, and whenever they are intended to be grown extreme care should be taken to see that the "seed" has not been obtained from an infested crop. Members of *H. marioni* are such minute organisms that they are quite capable of being carried in the soil adhering to the "seed" without being apparent to the naked eye.

Flower gardens are also undoubtedly a source of infestation in cases where infested material is thrown on to the manure heap and then later transferred to the fields. Infestation from such a source can be spread by surface drainage or wash and by implements and the feet of persons and animals. Initial infestation may have been introduced to the garden through diseased seedlings or soil from an infested patch.

To assert that water-logging is a source of infestation is definitely incorrect. Because the soil in a particular area happens to be water-logged, it does not necessarily indicate that eelworm are bound to be present there. But in cases where they are, a careful survey of the field would probably show that eelworm are also present in better-drained areas. What has probably given rise to such an idea is that root-knot is often more obvious in damp, poorly-drained localities than in drier ones—eelworm either having been introduced there through mechanical agencies (mainly surface drainage, for such areas are generally low-lying) or else been naturally attracted there from drier parts of the field. The damp condition would be highly favourable to the pest.

One of the persons who declares water-logged areas to be a source of infestation, suggests as a measure of control either sub-soil ploughing or the growing of cotton to break the hard pan. He should be advised that cotton is a host of *H. marioni* and so by growing cotton on infested land one would be assisting the eelworm instead of destroying it.

A précis of the more valuable information extracted from replies to question 8—"Have you any procedure which overcomes or appears to reduce this infestation? If so, what?" is given below:—*

A. Ploughing.—(*a*) Plough early and then again after two or three months. Reduces infestation.

(*b*) Ploughing as often as possible reduces infestation.

(*c*) Frequent stirring up of the land by ploughing and by early ridging reduces infestation.

(*d*) Ploughing in July and again in September reduces infestation to a slight extent.

B. Fallow.—Allowing infested land to lie fallow for four or five years without any cultivation or ploughing, greatly reduces infestation but does not eradicate it.

C. Drainage.—(*a*) Design an elaborate but simple system of drains around fields to carry away any nematode infested wash. Drains to lead into a vlei.

(*b*) Prevent wash from infested lands running on to seed-beds or source of water supply.

D. Seed-bed Water Supply.—(*a*) Use only borehole water. Seed-beds watered from river are infested, those from borehole are not infested.

(*b*) Use borehole water, or failing that sink pumps in mid-stream.

(*c*) Where possible do not use water from streams near old native lands or gardens.

(*d*) Use water from wells. When so doing, beds found to be free from infestation. Previously water was drawn from a river and eelworm were observed in seed-beds.

(*e*) Use only virgin site for seed-beds and not one situated on a public river, but on an internal spring or spruit on the farm where no garden or compound is within miles.

E. Burning.—Plant infested land to maize for three years and then trench and fill in trenches with old hay. Take

*It should be noted that a number of the observations made are based on the experience of one farmer only and were not subsequently checked. They are not given in this report as recommendations for general acceptance.

care also to cover the ground in between the trenches. Set alight. No sign of root-knot observed on tobacco planted after this treatment.

F. Unslaked Lime.—Thoroughly dig infested bed, apply unslaked lime and then water heavily. No eelworm observed after this treatment. Antirrhinums were the plants experimented with.

G. Stumping.—Stump new lands at foot of ridges or hills (*i.e.*, stump less elevated areas first) and provide suitable drains to carry away all storm water into vleis and not on to bush land which may be required to be used for tobacco at a later date.

H. Garden Refuse.—Prevent wash from flower gardens being introduced to seed-beds or lands, and destroy garden refuse.

Various suggestions have been mooted by other growers, but as they are not feasible (*e.g.*, one person suggests as a measure of control the removal of all host weeds from the entire farm) or are already being tried out at the Tobacco Research Station, mention will not be made of them in this report.

SUMMARY.

1. Nematode infestation is general throughout the tobacco growing areas of Southern Rhodesia and is not confined to any particular districts.

2. Of the 153 farms under review 77.1 per cent. are troubled with eelworm to a lesser or greater extent. On eleven farms more than 50 per cent. of the total cultivated land is infested, and in one particular instance the intensity of infestation is so severe that the owner has been driven out of the tobacco business owing to it being impossible to grow a remunerative crop.

3. Owing to the rapidity with which *H. marioni* are capable of reproducing, and the ease with which infestation is spread, the problem is a very serious one indeed. Sixty-eight farmers state that they have definite evidence of the spread of infestation during recent years.

4. Native gardens and land previously cultivated by natives are not necesarily sources of infestation—though in many cases they are liable to be, owing to the presence of nematode in host crops and weeds.

5. River water has been proved in experiments conducted by the writer at the Trelawney Tobacco Research Station to be one source of infestation. The eelworm are probably washed or scraped into the water from the roots of host plants growing on the banks or in infested gardens and lands in the vicinty of the river. Even a single female eelworm introduced into a tobacco seed-bed is an imminent source of danger as parthenogenetic reproduction is quite normal and regular.

A large proportion of the tobacco growing community hold similar views on this question.

6. Approximately 34 per cent. of the farmers who replied to the questionnaire claim to have observed eelworm in virgin land. Similar positive observations have been made by the writer.

7. In addition to infested seed-bed water supply, infested native gardens and indigenous weed hosts being sources of infestation, the pest can be very easily disseminated from diseased lands and flower gardens through mechanical agencies such as surface drainage, implements and feet of persons and animals.

8. All lands should be properly drained to prevent infestation spreading from one field to another. Similar steps should be taken to prevent the wash from infested lands and native gardens reaching the seed-beds or polluting the seed-bed water supply. Drains should not lead into a vlei as is advocated (in the body of the report paragraph *C*), by certain farmers, for by so doing the pest will be introduced on the feet of animals and persons to fresh areas of the farm.

COMPOST.

By S. D. Timson, M.C., Assistant Agriculturist.

I.—MODIFIED METHOD FOR COMPOSTING MAIZE AND WHEAT WASTES.

In an article recently published in this journal (Departmental Bulletin No. 1048) the technique for composting crop wastes on the Indore system with certain modifications by the writer were described. The chief item in the cost of making such compost from the crop wastes on the farm will be the collection and carting of the materials to the composting sites. The means of transport available on Rhodesian farms for this work, that is the ox wagon and Scotch cart, are extremely clumsy, inefficient, and unsuitable for the work. They are also very wasteful of ox-labour for pulling them, and of human labour in filling and emptying them. They are, in addition, very costly. Furthermore, the work of collection and carting of the materials for composting will compete for the use of the wagons with essential work such as the transport of the maize crop to the railway.

For the above reasons it is clearly desirable under local conditions to cut down as far as possible the collection and transport of the crop wastes for composting, and with this in view the following modified technique for treating the large quanties of maize wastes at the shelling dumps, and wheat wastes at the threshing sites, is advised.

Up to date many farmers have been in the habit of destroying this most valuable organic matter by burning. In the case of maize wastes this has been rightly done in the past in order to check the spread of diplodia and allied diseases, and also of weevils, because it is considered by competent authority that they may not be destroyed if converted into kraal manure, owing to the low temperatures which obtain in the manure heap. There is now no excuse for this criminal waste of the material most urgently required in our

Rhodesian soils, namely, organic matter, since these wastes can be converted safely, cheaply, and easily without any artificial water supply, and without the need to use anything that is not to be found on every farm, into first-class humus, by composting them.

Suggested Technique.—The modified technique of composting suggested for treating maize and wheat wastes at the dump is very simple, and is given below and is followed by a more detailed explanation of certain points.

(1) Erect a cattle kraal at the shelling or threshing sites.

(2) Place the maize husks and cores, or the wheat and barley straw, in the kraal to the depth of about two feet.

(3) Keep cattle in the kraals until sufficient dung and urine has been dropped by them, and until the depth of trampled wastes in the kraal is about 18 inches. Fill the wastes into the kraal daily as the cattle tramp them down.

(4) Divide the trampled mass in the kraal into heaps 16 feet wide, and over every 9 yards length of the heaps spread one or two bags of wood ash (or a third of this quantity of agricultural lime), and six bags of top soil.

(5) Fork over the heaps well, mixing all materials together, and taking care to mix the saturated materials from the bottom with those on the top.

(6) After about three inches of rain have fallen in October or November, build the heaps up into new heaps 9 feet wide by 3½ feet high by forking from the sides in towards the centre line.

(7) Turn the heaps once a month, on rainy days if possible (except during heavy continuous rainy spells) until the end of the rains, when the compost should be ripe and ready for carting to the fields and ploughing under.

It will be clear from the above description that the method is extremely simple, and eliminates practically all transport of materials, except the small quantity of wood ash required.

It will be most convenient for the subsequent handling of the compost if the kraal is made 16 feet, 32 feet or some other multiple of 16 feet wide, since the trampled mass of wastes and dung has later to be split up into heaps 16 feet in width.

If the kraals are made with a large enough gate at each end the straw or maize husks can be drawn into the kraal by a hay sweep, and hand labour thereby saved.

It is thought that it will be best to erect a temporary kraal each winter, since after it is filled it can be quickly removed, and will then not interfere with the subsequent work in which hand labour can be saved by using dam scrapers, ploughs, hay sweeps or similar ox-drawn implements for assisting in turning the heaps.

The maize cores should be thinly spread over the surface daily, so that they will be well distributed through the mass. These may not completely rot down in the compost heap, but will become so soft that they will rapidly break down in the soil. Where hand shelling is done it will be best to burn the mouldy cobs, since these will add little bulk to the compost, and their destruction will help to prevent the spread of disease.

The maize stalks and any other handy vegetable wastes from neighbouring fields can be conveniently placed in the kraal in thin layers daily. A generous layer of at least 12 to 18 inches depth should be placed in the kraal to start with, so that the urine may be absorbed and saved from loss as far as possible, since this is a most valuable by-product from the cattle because of its high nitrogen and potash content.

It is not possible at this stage to state what length of time the cattle must be kept on the wastes. This can only be found out by experience, but it is obviously desirable to discover the minimum so that there shall be no large losses of nitrogen owing to the surplus of dung and urine. Such a surplus of dung and urine could be profitably employed elsewhere as agents for breaking down additional organic matter to humus. If the latter is not available then there is no objection to keeping the cattle rather longer in the kraal than is strictly necessary, and it will assist in speeding up the rotting of the compost, and the maintenance of a high temperature.

The first turn of the heaps laid down above is designed to prevent the loss of nitrogen through the denitrification, which would otherwise take place owing to the compacting of the bottom layer of wastes and dung. Denitrification is brought about by the action of certain types of organisms, which chiefly work in the absence of air, and this condition is brought about by the compacting of a heap by the trampling of the cattle. During the process nitrogen is lost in various gaseous forms: as ammonia, oxides of nitrogen, and as nitrogen gas. In this and in all subsequent turns care should be taken to leave the heaps as open and loose as possible, and any compact portions should be broken up with the fork. Always in turning put the outer and less rotted layers inside the heap, and *vice versa*.

Destruction of Weevils and Diseases.—This is particularly important in the case of maize wastes in order that weevils and the spores of diseases such as those of the diplodia group shall be killed by the temperature of the interior of the heap. For the same reason in treating maize wastes, if necessary, more frequent turns may be given to ensure the development of a high temperature in the heap.

The soil added to the heaps, too, should be taken from the immediate area of the shelling dump, so that weevils in the grain tramped into the surface may also be killed.

In composting maize wastes the heaps should always be in readiness awaiting the commencement of the seasonal rains rains in October, so that weevils may be killed as soon as possible.

Comparison with Indore Composting.—It will be clear that in the modified technique described above that the quantity of nitrogen supplied in the dung and urine of the cattle cannot be so well regulated so as to avoid waste as in the normal methods developed at Indore. A certain amount of waste may take place owing to the use of more dung and urine than is necessary, and also because some losses of nitrogen by denitrification whilst the cattle are in the kraal will probably take place owing to the compaction of the lower layers of wastes.

However, this will be a matter of less importance where the farmer has insufficient supplies of organic materials (crop wastes, sunnhemp, grass, etc.) for converting into compost. Furthermore, experience will soon teach the farmer to reduce these losses to a minimum by finding the minimum time necessary for keeping the cattle in the kraal.

It will probably be found in practice that the amount of dung and urine supplied by the cattle can be reduced below the minimum necessary for rapid rotting of the compost, without unduly slowing down the process. This will automatically reduce the losses of nitrogen to a minimum and should even lead to appreciable gains of nitrogen from the air, by nitrogen fixation.

One considerable advantage this method will have in this Colony over the ordinary Indore composting is that the urine will be more fully and more economically employed, since urinated soil is not available on most Rhodesian farms in sufficient quantities, and the urine is usually almost entirely lost. This better utilisation of the urine is of considerable importance, since it contains much nitrogen and potash.

The greatest advantages claimed for the modification are, however, that both ox labour and human labour are saved, and it is considered that these economies will more than outweigh the possible losses.

II.—PERMANENT CROPS FOR COMPOSTING.

On most farms in the Colony there will usually be a lack of organic materials for composting rather than a lack of animal dung, although, as the supplies of compost are increased, so will the quantity of crop wastes automatically increase owing to the better growth of the crops.

In order to increase the quantities of organic materials for composting, and at the same time economise labour in carting them, much may be done by planting permanent crops, which produce a large bulk of organic matter per acre, and by composting them on the system advised above for composting threshing wastes of the wheat and maize crops, that is by commencing the process in a kraal under the feet of cattle.

The permanent crops suitable for the purpose such as those mentioned below, should be planted on all the small awkwardly shaped pieces of land, which are to be found on most farms (particularly where hills are present) which are uneconomical to work. There is, too, much heavy black soil in the maize belt, which only yields good crops in dry seasons, which can be used in this way. Such more or less waste land can be very profitably employed in producing compost to enrich the cultivated land, and at the same time provide valuable fodder reserves for periods of scarcity.

The crops considered most suitable for the purpose are given below, with a brief note on the conditions best suited to each, and the methods of propagation.

Any crop, however, which will produce a large bulk of organic matter can be utilised, and on many farms one is already established in the reeds growing on the banks of rivers and streams.

Napier Fodder (*Pennisetum purpureum*) also called Elephant grass and M'fufu.—This strongly stooling perennial grass may attain a height of from 10 to 18 feet, and on rich soils will produce 25 tons of green matter per acre in a year. It prefers a deep, well drained soil, but will grow quite well on any soil, which is not infertile or waterlogged. It grows better in the warmer areas of the country, but nevertheless grows well up to altitudes of 5,000 feet above sea level.

It may be propagated from seed, or by root-division or from cuttings. The two latter methods are most satisfactory, and for extensive plantings the use of cuttings is best.

Cuttings should be taken from mature stems, and should be about 12 to 18 inches long. The simplest method of planting them is to drop the canes in the outside furrow, behind a three furrow disc-plough, every two feet. They are then covered at the next stroke of the plough. The work should be done just before rain if possible, so that the rain will consolidate the soil round the cuttings.

In hand-planting rooted slips or cuttings any convenient spacing from 2 x 2 feet to 4 x 4 feet may be used, but a spacing of 4 feet between the rows is advised, since this will

allow the sowing of cowpeas, sunnhemp, or brown horse gram each year to assist in maintaining soil fertility. These inter-sown crops can be grazed off by stock after the Napier fodder has been cut.

Sugar Cane or Cow Cane.—This crop is not so hardy nor so prolific as Napier fodder on well drained soils, but it will grow under wetter soil conditions than that crop, though it does not thrive on really water-logged soils. It thrives better on heavy moist black soils than on the moist sandy soils. It is propagated in the same way as Napier fodder, but cuttings of the year-old canes are usually used. The upper sections are cut into lengths having four or five buds on each, and planted so that they just overlap in the furrow.

Rhodesian Sudan Grass (*Sorghum arundinaceum*).—This tall perennial grass is found growing wild throughout the areas of heavy soil. It appears to prefer well drained soils, although the writer has found it growing luxuriantly on heavy black soils, which become waterlogged during wet spells and are unsuited to maize. It has fine stems compared with Napier fodder, and it only produces about two-thirds of the weight of green matter produced by that crop. It has, however, the great virtue of being very resistant to both drought and heavy continuous rain. It has yielded 16 tons of green material per acre on the Salisbury Experiment Station, and should give higher yields than this in warmer areas such as the Mazoe Valley. It is propagated from seed and a suitable rate of seeding is 3 to 4 lbs. per acre in rows 18 inches to 20 inches apart; for broadcast sowing 15 to 20 lbs. per acre. It is a free seeder, but the seed ripen unevenly, and to obtain a full crop of seed it should be reaped by hand as it ripens. Although this crop does not produce the same bulk of organic material as Napier fodder, it will probably prove most popular, because it is easily propagated from seed.

One to one and a half pounds of seed will sow an acre for a seed crop in rows 36 inches apart, and it should produce $1\frac{1}{2}$ to $2\frac{1}{2}$ bags of seed per acre.

When to Cut for Composting.—No hard and fast rule can be laid down with regard to the best stage of growth at which

to cut the above crops for composting on the lines of the modified technique laid down above.

It will depend on a number of factors which will vary with the needs of the individual. If the compost is required for use as early as possible, the crops should be cut at about the half-mature stage, since they will then more readily rot down owing to their higher nitrogen and lower wood content. If speed is not of importance, and it is desired to obtain the largest weight of humus in the most lasting form, then they should be cut at the almost mature stage. The stems will then contain much wood and less nitrogen, and it will be necessary to keep the cattle in the kraal for a longer period, in order to break up the hard stems, and in order to supply more nitrogen in the form of dung and urine.

To obtain the highest possible yield of compost per acre within the rotting period of one rainy season, it may be necessary to pass nearly mature Napier fodder and cow cane through a chaff cutter, since, when mature, or nearly so, these crops have hard woody stems, which are resistant to the action of the fungi, which commence the breaking down.

In every case the materials should be allowed to dry out for a day or two before placing them in the kraal. If placed in the kraal or compost heap in a live green condition, much organic acid is formed which is unfavourable to the organisms of decomposition, and brings about conditions tending to preserve or ensile the materials. A further important reason for drying or withering the green materials before composting is that when in the green sappy state they pack together, and thus prevent the entry of air, an ample supply of which is essential to the proper aerobic decomposition aimed at in composting.

III.—KRAAL MANURE *versus* COMPOST.

Until the introduction of the modified Indore composting method of producing organic manure or humus with rain as the only source of water supply, the making of kraal or farm-yard manure was the only cheap practicable method of utilising crop residues and waste organic matter, which had found favour in this Colony. The defects of the process were, since there was no suitable alternative, ignored, and its

virtues only were extolled. Because of this many farmers have difficulty now in appreciating why the making of kraal manure is condemned as a wasteful and insanitary process, and the making of compost is advised in its place, whenever this is economically possible.

A comparison of kraal manure with compost may be briefly summarised thus:—

KRAAL MANURE.	COMPOST.
1. Crop diseases and pests not destroyed, and maize wastes therefore cannot be safely placed in kraals.	1. Destroyed by high temperatures, except, possibly, for certain tobacco diseases.
2. Weed seeds not killed.	2. Weed seeds killed.
3. Losses of nitrogen may exceed 78 per cent., during making and application to soil.	3. Gains of 4 to 26 per cent. of nitrogen made from air, during making; losses during application negligible.
4. Losses of potash may exceed 50 per cent.	4. Losses of potash much reduced.
5. In seasons with cold and wet commencement crops do not respond to kraal manure owing probably to the slow availability of the nitrogen content.	5. Plant foods in compost rapidly available, and crops respond to it even in cold and wet seasons such as that of 1937-38.
6. Is very wasteful of animal dung and urine.	6. Dung utilised economically, and urine partially.
7. Forms the ideal breeding ground for flies.	7. Flies cannot breed in properly made compost.

Some of the above items require further explanation.

Inefficiency of Kraal Manure in Cold Wet Seasons.—With regard to the inefficiency of kraal manure in seasons when the openings months are wet and cold it has been found in the rotation experiments at the Salisbury Experiment Station that in such seasons maize to which 8 tons of kraal manure per acre has been applied shows practically no response to the treatment. In the present season the maize dressed with kraal manure again shows little or no response to the treatment.

These facts are illustrated in the following table of yields in Rotation F., in which three-quarters of the land is under maize and one-quarter of the land is under Sudan grass reaped for hay.

	Maize plus 8 tons kraal manure per acre.	Maize following maize plus kraal manure.	**Rainfall.** December.	January.
1924-25	8.65 bags	21.75 bags	13.12 ins.	10.51 ins.
1928-29	10.15 bags	14.55 bags	5.45 ins.	11.50 ins.
1932-33	10.75 bags	9.72 bags	7.30 ins.	9.60 ins.
1934-35	6.99 bags	6.05 bags	7.66 ins.	9.60 ins.
Average yields	9.13 bags	13.01 bags		

The yields of maize are given in bags of 200 lbs. each per acre.

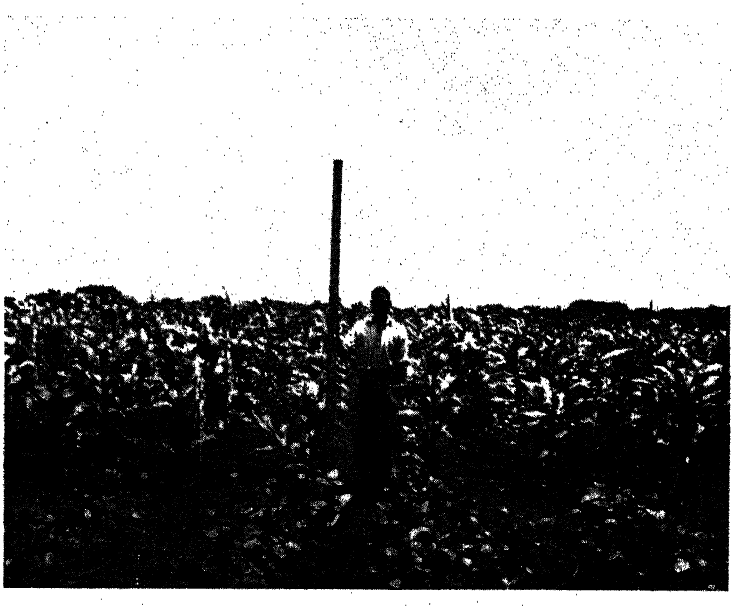
It will be seen that in these four years the maize following maize, which received 8 tons of kraal manure the previous year, has yielded on the average about 4 bags per acre more than the maize which received a dressing of 8 tons of manure per acre.

Whatever may be the reasons for the ineffectiveness of the kraal manure in seasons in which the first two months are wet and cold, the fact that it may be largely wasted in four seasons out of 10, as shown by the results obtained on the Salisbury Experiment Station during the last 10 years, is a matter of great importance to the practical farmer, and a strong argument in favour of a change to composting as the method of humus manufacture.

It is probable that this failure of kraal manure in seasons having a cold wet opening is due to the fact that the nitrifying bacteria in the soil are unable under the cold and wet conditions to convert the organic nitrogen into the mineral, soluble form, in which form only is it available to the maize crop.

At the same time these wet cold conditions are also unfavourable to the activity of the free-living nitrogen fixing bacteria, which fix the nitrogen from the air, and so the crop cannot get its immediate requirements of nitrogen from this alternative source.

Rotational System H. Maize after green-manure ploughed under plus 200 lbs. per acre superphosphate. Compare with maize which received farmyard manure in System F and note the healthier growth on this plot.



Rotational System F. Maize plus farmyard manure. The manurial treatment had very little effect on the yield of maize.

Loss of Nitrogen.—With regard to the losses of nitrogen during the making and application of kraal manure, it has been shown by research in England* and on the Continent† that even where the best methods of making and storing under cover are used that the loss of total nitrogen from bullock manure may exceed 78.3 per cent. When the dung was removed from deep stalls about 15 per cent. of the total nitrogen had already been lost. After storing in a heap under cover a further loss of up to 42 per cent. of the remaining nitrogen was lost. During exposure of the manure on the field for four days prior to ploughing it under a further 52 to 60 per cent. of the remaining nitrogen was lost.

In a field test of the manurial value of manure applied to oats, barley and turnips, it was found that "in the first year of application dung exposed for four days before being turned in was equivalent to half the same weight of manure ploughed in at once." This is largely due to the loss of nitrogen in gaseous forms.

It is interesting to speculate on how much greater these losses of nitrogen are from kraal manure made under the usual Rhodesian conditions, which could hardly be worse.

On the other hand Howard and Wad showed that during the making of Indore compost, gains of nitrogen from the air amounting to from 4.4 up to 26.3 per cent. may be made.

During storage in heaps for one month they found the losses of total nitrogen amounted to only 0.04 per cent.

There is much evidence of the slow availability of the nitrogen in farmyard manure even under favourable conditions, and under the unfavourable conditions of long continued spells of wet weather it appears that this nitrogen never becomes available to the maize crop in time to be of use, since it must be remembered that annual crops require nitrogen chiefly in the early stages of growth.

*Technical Communication No. 33 of the Imperial Bureau of Soil Science. 1935 pp. 7 to 10.

†Journal of Ministry of Agriculture, Vol. XLII., No. 12; 1936, p. 1231.

Howard and Wad* have shown that the nitrogen in Indore compost is readily available, and the writer has seen convincing evidence in the field this season that it is readily available even under the continuous wet and cold conditions which obtained in the first two months of the growing season. Maize to which compost had been applied exhibited the normal response to nitrogen shown by the vigorous dark green growth of stems and leaves.

Waste of Dung and Urine.—In the making of kraal manure or farmyard manure, much more dung and urine are employed than are actually necessary to supply the minimum quantity of nitrogen to enable the fungi and bacteria to bring about the decay of the bedding and the crop wastes. This excess of nitrogen is almost entirely lost in gaseous forms, or is leached out by rain as nitrate. If this wasted nitrogen were properly employed in the rotting down of more crop wastes, bedding, etc., by making compost, this loss could be avoided, and much greater quantities of humus could be made on the farm for building up and maintaining the fertility of the soil. Until the introduction into this Colony of the Indore method of composting organic matter it was not possible to utilise safely the great quantities of maize wastes available each year, owing to the danger of spreading diseases and pests by converting them into kraal manure. This tremendous waste of most valuable humus-forming material may now be safely utilised in the making of compost, and at the same time much of the huge loss of nitrogen from the cattle kraals of the Colony prevented.

Destruction of Flies.—As is well known flies are one of the most important agents in carrying bacteria, and to the dairy farmer in particular they form a constant source of infection of his milk and cream, and in consequence are a constant and serious threat to the quality of these products.

Few dairy farmers require reminding of this fact, but they may not all realise that this source of loss can be largely avoided by eliminating the insanitary kraal and manure heap in favour of the compost heap.

*The Waste Products of Agriculture: Howard and Wad.

Cattle kraals and manure heaps are the chief breeding places for flies, but these pests cannot breed in properly managed compost heaps owing to the high temperatures of the interior. It is necessary, however, to turn the heaps sufficiently frequently to ensure that any eggs and larvae present in the cooler surface of the heaps are killed by placing the outer layers of the heap in the centre whilst turning.

Flies are also a source of loss to the farmer in that they seriously interfere with the peace and comfort of farm animals, and an animal which is not comfortable can never yield the maximum profit to the owner. It is also necessary here to point out once again that flies are one of the chief carriers of human diseases, though it is hoped that no one is now unaware of this very serious aspect of the fly nuisance.

Some Trees Shrubs, Shrubby-Herbaceous Plants, Climbers and Water Plants

SUITABLE FOR THE COLONY.

By J. W. BARNES, Manager, Government Forest Nursery, Salisbury.

(Photographs by the Author.)

(*Continued.*)

Callistemon speciosus (Bottle Brush).—A small tree up to 20 feet in height with bright red flowers; the tree has a weeping habit, and is a graceful object when well grown. It makes a good hedge, but must be clipped regularly by starting near the ground, to make a thick hedge. Also in use for avenues, where it should be planted at 20-25 feet apart. Hardy. Several other varieties have all been grown with success from seeds.

Callitris calcarata (Black Cypress Pine).—A small tree to about 40 feet, excellent for grouping effects; a useful species for timber or landscape and used also for hedges. Seeds.

Callitris glauca.—Very similar to *C. robusta;* good in the hot districts but not on diorite. Hardy. Seeds.

Callitris rhomboidea.—Has been used as hedges only. Seeds.

Callitris robusta (White Cypress Pine).—Growing to 30-40 feet high; is a very good timber and ornamental tree, has glaucous foliage. Hardy. Seeds.

Callodendron capensis (Cape Chestnut).—Discovered to be indigenous to this Colony. It is a fine flowering tree, with white spotted purple flowers, but is rather slow in cultivation. Seeds.

Calpurnia aurea.—A small shrub about 6 feet high, with laburnam-like yellow flowers. Seeds.

Cæsalpinia sepiara (Mauritius Thorn).—An extremely strong-growing thorny shrubby half climber, mimosa-like leaves, and very handsome heads of yellow-red flowers. It makes excellent cattle proof fences and requires plenty of room. Seeds.

Carica papaya (Paw Paw).—A large herbaceous plant up to 15 feet in height, and bearing a well-known fruit; a short-lived plant; and requires renewing every 3 or 4 years for the best results. Tender to frost. Seeds.

Carissa grandiflora (Amatungula).—Thorny bush with dark shining foliage, deciduous here unless watered, bears small purple plums which are edible. Seeds. Other species are indigenous to the Colony.

Caryota urens (Fish Tail Palm).—A very handsome palm growing to over 20 feet. Seeds.

Casimiroa edulis (Mexican Apple).—An extremely fast-growing large evergreen tree, height 30-40 feet, dense foilage, weeping habit, and with an edible fruit rather larger than a golf ball. Seeds.

Cassia capensis (Cape laburnam).—A showy yellow-flowered shrub which flowers profusely in the Autumn; about 6-8 feet high. Hardy. Seeds.

Cassia siamea.—A small evergreen tree, about 25 feet in height, with bright green shining leaves, and heads of pale yellow flowers. It is very tender to cold when young and must be protected. Seeds.

Castanospermum Australe (Australian Chestnut).—A fine shade tree resembling Cedrela, but with bright shiny foliage, bearing orange-red flowers produced close to the stems, in early Spring. Hardy. The best results will probably be obtained by sowing *in situ*. Seeds.

Casuarina cunninghamiana (Beefwood).—A very hardy tree and will thrive in most unlikely places. Seeds.

Cedrela odorata.—A similar tree to the toon, but not so hardy in the young stages, requiring protection for the first winter; both by seeds.

Cedrela toona (The Toon).—A large shade and timber tree introduced in 1910; thrives to perfection in the heavy soils, and is used most extensively for street work, where it is planted 20 feet apart, which is too close; should be at least 30 feet apart; the timber is an excellent cabinet wood. Very hardy.

Ceratonia siliqua (Carob Bean).—Has been grown in the Umtali District and tried elsewhere; a small evergreen tree, 20-30 feet in height, bearing the beans known as locust beans, an excellent stock feed; trees are of little difficult to establish. Seeds.

Cestrum aurantiacum (Ink Berry).—A large shrub up to 10 feet high, with orange yellow tubular flowers. Cuttings.

Cestrum elegans and other kinds also do well. Cuttings.

Chamærops elegans.—A slow-growing, but useful palm, has fan-shaped leaves; has reached 10 feet in height. Seeds.

Chamærops excelsa.—A palm similar to above. Seeds.

Clerodendron fallax.—A small shrub, about 3 feet in height; makes a wonderful show with its scarlet flowers. Cuttings or seeds.

Clerodendron thompsonæ or balfourii.—A hardy climber, best grown on a wall; has bright flowers of pure white and scarlet. Cuttings.

Clitoria ternatea (Mussel Shell Creeper).—A strong climber, with delightful blue flowers. Seeds or cuttings.

Cobæa scandens.—A strong climber, and will cover considerable space; reddish-purple flowers and very useful where a quick climber is needed. Seeds.

Cocos plumosa.—A fine palm, tall-growing, with large feathery leaves. Seeds. Difficult to germinate.

Cortaderia argentea (Pampas Grass).—Growing to 8 feet high, is a handsome plant, with its long plumes of white seed heads; best grown near a leaky tap, or in the water garden. Offsets.

Cratægus coccinea (Hawthorn).—Growing to about 6-8 feet, is a showy shrub when in berry. Deciduous, white flowers, berries golden red. Seeds.

Cratægus oxyacantha (Hawthorn).—Shrubby tree, height 10 feet, deciduous, covered with orange-red berries during the leafless period. Seeds.

Cratægus pyracantha (Hawthorn).—An evergreen spinose shrub, dark green foliage, small white flowers, scarlet berries; makes an excellent hedge. Seeds.

Crotalaria Juncea.—This well known plant is the Sunn-hemp, and is used extensively for green manuring; all Crotalarias propagated by seeds.

Crotalaria sp.—Some are fair-sized shrubs, and others small plants with yellow flowers; several species are indigenous to the Colony.

Croton sylvaticus (Mount Selinda Linden).—A indigenous tree from the Eastern Border, broadleaved, deciduous; a good shade tree up to 30 feet in height. Seeds.

Cryptomeria elegans.—A smaller tree than *E. japonica*, but also a very valuable tree on the Eastern Border; foliage turns a beautiful fiery red in Autumn; for the wet districts only. Seeds.

Cryptomeria japonica (Japanese Cedar).—A coniferous timber tree, which has grown to over 40 feet in height; a handsome specimen tree; will become a valuable tree on the Eastern Border, but most other districts are too dry for it. Seeds.

Cryptostegia grandiflora.—A rough and strong half climber, but usually grown as a shrub, has fine pinkish-mauve trumpet-shaped flowers, and shiny green foliage. Seeds.

Cupressus arizonica (Arizona Cypress).—A very hardy Cypress suited to the hot districts; a good hedge variety.

Cupressus funebris.—A hardy small tree for the warm districts; slow in growth.

Cupressus Lawsoniana.—A very handsome variety; for the wet districts.

Cupressus lusitanica (Portuguese Cypress).—It is the most successful species of Cypress in the heaviest rainfall areas,

growing almost like a weed on the Eastern Border; it is inclined to die out during the dry winters in the warmer districts.

Cupressus sempervirens horizontalis.—A variety which does well and is very hardy.

Cupressus sempervirens pyramidalis (Chimney Cypress). —A tall Italian Cypress; very successful in Mashonaland.

Cupressus torulosa (Himalayan Cypress).—A most successful tree in Mashonaland, and also doing well in the driest parts of Matabeland; this handsome tree is widely used for timber and ornament.

All the above Cypresses are raised from seeds.

Cyathea dregei (Tree Fern).—Many thousands are to be seen, standing like long lines of sentinels, on the Inyanga plateau, and show where there is running water; they range from a few inches to 15 feet in height; can be grown successfully in tubs, but require a sheltered verandah away from the prevailing winds, when cultivated. Plants.

Cydonia japonica (Flowering Quince).—A deciduous small shrub about 4 feet; flowers appear very early in Spring, about August, before the leaves, and are red in colour; useful for cutting. Cuttings.

Cyperus papyrus (Papyrus Grass).—Indigenous to the Colony; this handsome grass will thrive if planted near a leaky tap, and will reach a height of 10 feet in suitable places. Offsets.

Cyphomandra betacea (Tree Tomato).—A large shrubby herbaceous plant, about 6-8 feet in height, bearing edible fruits; plants must be renewed every few years; tender to frost. Seeds.

Dahlia imperialis (Tree Dahlia).—A tall perennial dahlia, about 8 feet in height; has fine heads of large single flowers, of a pinkish-white and is useful in a large shrubbery. Dies to the ground each year after flowering. Hardy. Seeds.

Dais cotinifolia.—A small tree producing small heads of lilac-like flowers; has grown to 10 feet high. Difficult to propagate.

Datura arborea (Potato Tree).—A large shrubby tree, very fast grower, height to 30 feet, flowers profusely, large bluish-purple. Tender in the young stage, leaves have strong thorns when young, but these disappear from the leaves as the tree gets older. Has large apple-like fruits which are probably poisonous. Seeds.

Dendrocalamus strictus (Bamboo).—A useful solid stemmed bamboo; about 15 feet in height and diameter of one inch; narrow leaves. Offsets.

Deutzia crenata (Bridal Wreath).—A small growing bush here, about 5 feet, with masses of double white flowers, tinged with pink. Cuttings.

Deutzia vilmoriana.—Similar, but with single white flowers. Cuttings or seeds.

Dodonea viscosa.—An indigenous shrub from the Eastern Border; has bright green narrow leaves, and will make an excellent hedge, but dies out after a few years in Mashonaland, but curiously enough it is about the best long-lived hedge in Bulawayo, where one would think it would not do at all. Seeds.

Dombeya sp.—Two varieties do well; one, a large shrub, has pale pink paper-like flowers; the other, a small shrub with deep rosy-pink flowers. Cuttings.

Dracæna reflexa.—A large species, growing to a height of 20 feet, leaves bright green, long and broad; excellent in the shrubbery for its tropical effects. Seeds or cuttings.

Duranta plumieri (Tree Forget-me-not).—Growing to about 15 feet high; there are several kinds growing well, some are very thorny, others without thorns; all have flowers practically the same in colour—blue. Also a white variety. Cuttings.

Eriobotrya japonica or *Photinia japonica* (Loquat).—The well known shrubby tree, producing yellow edible fruits in the Autumn. Seeds.

Erythrina caffra (Kaffir Tree).—A well known large indigenous tree with coral red flowers. Easily raised from seeds, or truncheons.

Erythrina crista-galli.—A small variety, about 4 feet high, usually sending out new growth each year from the base; has terminal spikes of red flowers. Seeds.

Eucalyptus Species.—The following species have been tried, and the district in which they have done best is stated.

E. amygdalina (Peppermint Gum).—Eastern Border. At Inyanga a good tree, tender to frosts while small.

E. botryoides.—Has grown well in Mashonaland on deep soils, and on Eastern Border.

E. calophylla.—Eastern Border, a good ornamental tree, about 20 feet in height.

E. citriodora (Lemon-Scented Gum).—Poor on Eastern Border, excellent in parts of Mashonaland. Sometimes tender to frost while small.

E. coriacea.—Has thrived on the Eastern Border, but not a good tree.

E. cornuta.—A small tree. Only on Eastern Border.

E. creba.—Fails in wet districts, fair in Salisbury, fairly good in Bulawayo.

E. diversicolor (Karri).—A few planted at Inyanga justify further planting there.

E. ficifolia (Red-Flowered Gum).—Good on Eastern Border, but cannot be considered a successful tree away from the wet districts.

E. globulus (Blue Gum).—Grown to perfection on Eastern Border, and wet areas; was also grown there successfully from seed sown *in situ*, 2 lbs. per acre; in five years, poles 45 feet in length were being cut out from these sowings.

E. hemiphloia (Grey Box).—Fair in the hotter districts.

E. longiflora (Wooly Butt).—Fair in Salisbury, probably do well on Eastern Border.

E. maculata (Spotted Gum).—Very fine trees at Umtali, fair tree in Salisbury, poor on Eastern Border mountains, yet excellent at Umtali where the altitude is much lower.

E. maideni (Maidens Gum).—Is doing well in the Midlands.

E. melliodora (Yellow Box).—A poor tree in Salisbury, better in Matabeleland.

E. microcorys (Tallow Wood).—Grown to perfection on Eastern Border; a small tree in Salisbury.

E. paniculata (Ironbark).—Grows well on Eastern Border, but is easily damaged by strong winds, does fairly well in the hotter districts; a good avenue tree.

E. pilularis (Black Butt).—A very fine tree on Eastern Border, and is a fair tree in Salisbury; tender to frosts when small.

E. polyanthema (Red Box).—Would make a good avenue tree in the warmer districts.

E. punctata (Leather Jacket).—Doing well on Eastern Border.

E. resinifera (Red Mahogany).—A very fine tree on Eastern Border, or wet districts, but not so good elsewhere; a large flowered type of this, *E. hemilampra*, has done remarkably well at Inyanga, where it has reached 70 feet in height in about 15 years.

E. robusta (Swamp Mahogany).—Doing well on Eastern Border, but only a small straggling tree in warmer districts.

E. rostrata (Red Gum).—One of the hardiest and best trees for the hot districts, doing well nearly anywhere if the soil suits it, but fails on Eastern Border.

E. saligna.—A very fine tree where there is a fair rainfall and deep soil, one of the best on Eastern Border; this tree has become mixed up with *E. grandis*, and most of the trees grown in Rhodesia are of the latter species; both do well in the wet districts.

E. siderophloia.—A success on the Eastern Border.

E. sideroxylon (Red Ironbark).—A fairly good tree in the warm districts.

E. stuartiana.—A good tree at Inyanga.

E. tereticornis (Forest Red Gum).—Shares with *E. rostrata* pride of place as the hardiest gum for general planting, but of no use in the mountain areas.

E. viminalis (Manna Gum).—Has done fairly well on sand veld around Salisbury. All the Eucalypts are raised from seed.

Eugenia braziliensis (Brazilian Cherry).—A small shrub useful for its fruit, which is made into a jelly; has been used as a hedge plant, but unsuitable as it is deciduous; excellent for game. Seeds.

Euphorbia fulgens or *jacquiniæflora*.—A beautiful variety, growing best on the sand veld; attains to about 6 feet high; has small star-shaped orange-scarlet flowers. Cuttings.

Euphorbia splendens (Christ Thorn).—A useful small thorny bush, 18 inches in height, usually covered with bright red flowers; is a useful and showy edging to small borders, or in the shrubbery. Also a large-leaved variety. Cuttings.

Exochorda grandiflora.—A shrub, has reached 6 feet so far, producing large pure white flowers, similar to mock orange, in early Spring and before the leaves appear. Seeds or cuttings.

Ficus capensis.—An indigenous fig, growing into a large evergreen tree. Seeds or cuttings.

Ficus macrophylla.—This is a fine evergreen fig, making a large shade tree, and thrives on very poor soil; will grow to 25-30 feet in height, and is inclined to branch close to the ground, but if pruned up can be made into a first-class specimen. Hardy in hot districts. Seeds.

Ficus religiosa (Peepul Tree).—A large handsome tree, very tender to frosts while small. Seeds.

Ficus repens.—A clinging fig, suitable for stonework or walls, to which it clings very closely; small leaves; evergreen; the young leaves are a brownish red, which is very attractive. Cuttings.

Ficus retusa.—A large spreading tree; evergreen with small shining leaves; very hardy; thrives at Bulawayo on

practically pure sand. Large surface roots are rather a drawback. Cuttings or layers.

Ficus sub-calcarata.—A large, dark-green-leaved fig, indigenous, making a fine large and spreading tree. Seeds or cuttings.

Furcroya gigantea (Mauritius Hemp).—Grows to perfection; has long leaves similar to *Agave rigida*, but of a yellowish-green colour, and about 5 feet long; the flowers are produced on long poles 15-20 feet in height, and are white; these are attractive in February-March and show up well in a large shrubbery. Suckers or bulbils. A variegated variety, is very ornamental.

Freylinea tropica.—A small indigenous shrub from the Eastern Border, about 6-8 feet in height, has small plumbago-like flowers; evergreen where it can obtain water; makes an excellent close hedge, but must be watered during the dry season. Seeds or cuttings.

Galphimia gracilis.—A small shrub, with yellow flowers; has been used as a small hedge. Seeds or cuttings.

Gardenia florida.—Heavy glossy foliage, and highly scented double white flowers; this is a good shrub, but likes plenty of water. Cuttings.

Grevillea caleyi.—A small tree, or shrub; evergreen; height about 8 feet; has red flowers. Seeds.

Grevillea robusta (Silky Oak).—A medium sized tree; evergreen; not very successful in Mashonaland where it is inclined to die back, but is used as a street tree in Matabeleland; is also used as a shade tree for coffee. Seeds.

Hamelia patens.—A fair sized shrub; evergreen where it can be watered; dark green foliage; orange-yellow flowers, followed by small blue berries. Cuttings.

Hedera helix (Ivy).—Too well known to need description; the ivy needs shade and cool conditions, even then is not very successful here. Cuttings.

Heliotrope sp.—Small garden shrubs; good varieties may be raised from seeds, which vary in colour and size; sweetly scented flowers of a lavender colour. Seeds or cuttings.

Hibiscus mutabilis.—A hardy shrub growing to 10 feet high, inclined to straggle; has large single pink flowers, similar to the single hollyhock. Seeds or cuttings.

Several varieties of Hibiscus occur in this Colony, including *Hibiscus cannabinus*, which is a valuable fibre plant, and is to be found in most parts of the Colony, growing in places to 10 feet in height. Seeds.

Hibiscus rosa-sinensis.—This Hibiscus is too well known to need description; is used as hedges and as large shrubs. Several colours are in cultivation here, some with single, and others with double flowers. Cuttings.

Holmskioldia sanguinea.—A strong grower, to 10 feet in height, producing red papery flowers on long spikes, in March-June; very valuable as cut flowers. Cuttings.

Holmskioldia sp.—A yellow-flowered variety exactly similar to *Holmskioldia sanguinea.* Cuttings.

Hovenia dulcis.—A small tree; has grown fairly well, but seems to have nothing to recommend it.

Hydrangea japonica.—Small shrubs up to 4-6 feet in height; doing well in sheltered situations, and when well watered; also suitable as a verandah shrub in tubs. Cuttings.

Hymenosporum flavum.—A medium sized flowering tree, about 20 feet with rather scanty foliage and bearing trusses of large whitish-yellow scented flowers in spring. Seeds.

Hypericum lanceolatum (St. John's Wort).—A shrub indigenous to the Colony, rather large, deciduous away from the Eastern Border; has attractive orange yellow flowers, and flowers profusely. Cuttings or seeds.

Hypericum quartinianum.—Another variety indigenous to the country, with flowers similar to *H. lanceolatum;* smaller than the former in growth. Cuttings or seeds.

Iboza riparia or *Moschosma sp.* (Rhodesian Spirea).—A medium sized indigenous shrub; has aromatic leaves and large spikes of small purple flowers, flowering during the winter months; deciduous. Cuttings.

Jochroma tubulosa.—Of the Solanaceæ family; this is a shrub about 10 feet in height, and has deep blue tubular flowers about an inch and a half long; showy. A scarlet variety is very effective. Cuttings.

Jacaranda mimosæfolia.—Too well known to need description as it is grown by nearly everyone; used extensively for street work, and during the flowering period, September-November, the town of Salisbury is a blaze of lavender coloured flowers. This tree is tender to frosts and should be protected until it has reached a height of 5 feet. Seeds.

Jasminum primulinum.—A yellow flowered climbing shrub which is rather untidy unless kept tied in and trimmed. Hardy. Cuttings.

Jasminum sambac.—A strong and hardy evergreen semi-rambling shrub, with clusters of large white flowers. Cuttings.

Jatropha coccinea.—A handsame shrub, producing scarlet flowers and pretty foliage; is tender to frosts; the fruits are probably poisonous. Seeds.

Jatropha curcas (Purging Nut).—Has grown to 9 feet in height in three years, with a spread of 7 feet, and this year has produced 5 lbs. of seed. Is probably of economic value; tender to heavy frosts. Seeds.

Juniperus procera (Kenya Cedar).—A valuable timber tree from Kenya Colony, but is probably only useful in the warmer districts here for the shrubbery; has reached a height of 6 feet in four years. Should do well on Eastern Border. Seeds.

Juniperus virginiana.—Useful small tree with valuable timber; a very suitable conifer for the shrubbery in all districts.

Also *Juniperus Bermudiana.*—Seeds.

Kentia belmoreana or *Howea belmoreana* (Curly Palm).—Handsome palms; require protection of shade house or verandah; there are other species of the same genus. Seeds.

Kerria japonica.—A small shrub about 4 feet with pretty orange-yellow double flowers; flowers in summer. Cuttings.

Rhodesia Weather Bureau.

FEBRUARY, 1938.

Pressure.—The mean barometric pressure for the month was slightly above normal.

Temperature. — Mean maximum temperatures were generally above normal and mean minimum temperatures below making the average temperatures approximately normal.

Humidity.—The moisture content of the air as shown by the dewpoint was much below normal in the south and slightly below in the north.

Rainfall.—Rainfall in Southern Rhodesia as shown by the telegraphic summaries was well below normal in all areas averaging less than half the normal over the whole country with a deficiency of 3.4 inches. Up to the end of January the excess was about 2 inches, so that the position at the end of February showed a shortfall of about 1½ inches.

Weather and Air Masses.—The month as a whole was dry. Hardly any stations received a normal rainfall, and the majority recorded less than half the normal amounts.

The month opened with a vigorous inflow of cold southerly air, and clearing followed, though not completed in the north until the 4th. Weather continued fine until the 11th, practically all air movements in the meantime being from the East or South-east. Low pressure over Madagascar was responsible for this.

A pressure trough formed over the west of the country on the 11th, and brought in moist equatorial air from the north-west. Scattered showers resulted on the 11th, 12th and 13th. Some heavy falls occurred in the neighbourhood of the Umvukwes on the night of the 12th.

On the 13th a tropical cyclone developed near the N.E. coast of Madagascar, subsequently moving inland and losing its violent centre, later appearing over the Indian Ocean as a deep low. A further spell of south-east winds brought fine weather to Southern Rhodesia, lasting until the 18th.

At this stage the low over the Indian Ocean was too remote to affect our circulation, but a deep low formed over the centre of the Union on the 18th and moved eastwards. A flow of moist northerly air into Southern Rhodesia resulted, and a period of thunderstorms followed, lasting until the 24th in the south and continuing a day or so longer in the north. The establishment of an upper south-east current appears to have been responsible for clearing on this occasion.

Another pressure trough formed over Matabeleland on the last day of the month, and fairly general rain resulted.

PRECIPITATION.

Station.	Inches.	Normal.	No. of Days.
Beitbridge	0.16	1.52	4
Bindura	2.32	7.12	7
Bulawayo	1.67	3.90	5
Chipinga	1.57	7.20	3
Enkeldoorn	1.66	5.51	5
Fort Victoria...	3.57	4.70	5
Gwaai Siding	2.64	3.73	5
Gwanda	0.39	3.44	6
Gwelo	2.31	5.19	4
Hartley	0.54	6.71	5
Inyanga	3.22	7.52	8
Marandellas	2.51	6.91	6
Miami	2.68	6.23	9
Mount Darwin	6.55	6.74	8
Mount Nuza	3.70	9.64	13
Mtoko	1.48	5.87	6
New Year's Gift	0.71	3.85	3
Nuanetsi	0.71	2.35	6
Plumtree	2.17	4.43	6
Que Que	3.05	6.23	5

FEBRUARY, 1938 (continued)

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	Wet Bulb.	Dew Point	Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute: Maximum	Date	Minimum	Date	Number of Days: Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
lumtree	4,549	70.7	61.6	56	10.3	81.3	61.0	71.1	90	20th	54	5th	8	2	4	...	...	863.5	879.8	...	3.3	...
ue Que	3,999	69.7	64.6	62	6.0	83.3	60.3	71.8	91	19th	53	4th	12	1	2	...	71.2	881.0	880.2	...	4.4	...
usape	4,648	65.9	61.1	58	5.4	78.3	58.6	68.4	89	19th	53	6th	2	3	1	...	67.5	..	...	...	4.1	...
alisbury	4,831	67.6	62.0	59	7.8	79.8	58.7	69.3	87	20th	51	5th	4	2	1	...	68.2	855.5	880.7	853.9	6.4	8.7
aabani	3,131	73.7	65.0	60	10.7	84.8	62.8	73.8	97	18th	55	4th	14	2	8	...	73.1	...	...	...	3.0	...
inoia	3,795	70.0	65.7	63	5.3	82.7	62.6	72.6	88	19th	58	5th	7	...	5	...	71.5	887.5	880.4	...	5.2	...
ipolilo	3,876	70.4	64.6	62	7.2	80.2	61.3	70.7	88	20th	58	5th	3	...	1	...	...	884.4	880.2	...	4.3	...
tapleford	5,304	63.1	59.6	58	3.7	72.4	52.9	62.7	83	19th	45	27th	...	6	...	...	61.8	841.5	880.6	...	5.5	...
'mtali	3,672	70.7	64.9	62	7.2	83.2	60.7	72.0	95	19th	55	4th	10	2	2	...	70.5	891.9	881.2	890.2	5.1	8.8
'ictoria Falls... ...	3,009	72.9	68.6	66	5.6	88.5	65.9	77.2	97	20th	60	6th	22	1	15	...	75.3	910.5	879.8	...	3.8	...
Vankie...	2,567	76.3	69.5	66	9.2	89.9	68.7	79.3	100	20th	64	5th	23	...	26	...	78.3	925.3	879.7	...	3.3	...
.bercorn	5,407	65.9	62.8	61	3.4	75.9	59.4	67.6	82	28th	57	25th	...	1	...	...	...	837.5	880.2	...	5.3	...
roken Hill	3,920	67.6	65.2	64	2.8	80.3	62.4	71.3	87	20th	59	17th	1	...	...	...	...	883.2	879.4	...	7.4	...
.asama...	4,700	67.1	64.5	63	3.0	80.0	62.1	71.1	84	17th	60	15th	...	...	...	...	...	863.7	880.5	...	...	...
ivingstone	3,140	70.0	67.6	66	3.0	85.3	64.5	74.9	93	20th	59	6th	18	1	6	...	...	905.4	879.2	...	6.4	7.3
Iazabuka Res. ...	...	70.0	66.6	65	4.4	82.6	64.8	73.7	89	20th	61	6th	5	...	9	...	...	899.2	879.4	...	5.3	7.3
Iongu	...	72.2	69.4	68	3.7	84.6	67.5	76.0	92	9th	65	26th	12	...	25	...	...	895.8	878.9	...	...	...
Ipika	...	66.8	64.4	63	2.9	79.3	61.3	70.3	89	20th	57	15th	2	1	...	...	...	861.9	880.5	...	6.5	...
Iwinilunga	...	65.7	64.4	64	1.6	79.1	61.4	70.2	83	19th	59	var.	...	...	...	...	...	...	...	...	...	...
Idola	...	...	...	...	...	...	...	...	...		...		...	...	...	...	...	...	...	...	...	...

Rainfall in February, 1938, in Hundredths of an Inch. Telegraphic Reports.

Area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Total	Normal
1	5	...	...	...	...	...	...	...	...	...	1	2	...	...	...	...	...	...	3	2	3	12	5	5	...	...	...	53	91	378
2	27	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	122	8	17	...	8	...	...	...	55	245	540
3	31	4	...	1	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	9	...	56	1	11	...	...	...	...	113	794
4	8	...	...	...	...	...	...	...	...	...	1	27	...	...	...	...	...	...	22	13	44	39	3	3	...	...	...	4	164	615
5	3	32	1	...	...	...	...	1	...	...	3	53	11	17	1	...	...	8	11	19	13	17	57	1	...	...	...	19	267	508
6	...	...	...	...	...	...	...	...	...	...	...	9	...	...	...	...	...	...	5	26	9	...	25	10	...	...	...	11	95	707
7	31	3	...	...	...	...	...	...	...	...	...	15	9	...	...	...	...	...	4	28	27	7	20	67	7	...	...	50	268	656
8	3	18	7	...	1	...	...	...	...	...	...	95	1	...	...	...	...	...	5	4	36	3	44	117	23	2	...	125	484	705
9	25	24	18	1	...	...	...	...	...	...	1	79	10	10	...	...	...	...	5	2	9	...	51	31	67	21	...	25	379	648
10	103	4	17	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	24	...	...	251	...	...	...	...	401	611
Mean	17	10	4	..	...	...	...	...	...	...	1	27	4	4	...	...	...	1	7	27	15	12	24	30	10	3	...	34	230	568

Southern Rhodesia Veterinary Report.

JANUARY, 1938.

DISEASES.

Anthrax.—Disease diagnosed in the Mrewa and Fort Victoria native districts. Inoculation of all infected and incontact cattle has been completed. Mortality ninety-nine head.

MALLEIN TEST.

One horse and forty-eight mules were tested upon entry. No reactions.

TUBERCULIN TEST.

Two bulls and one heifer were tested upon importation with negative results.

IMPORTATIONS.

From the United Kingdom.—Bulls 2, heifer 1.

From the Union of South Africa.—Horses 1, mules 48, sheep 669.

From the Bechuanaland Protectorate.—Sheep 1,114, goats 89.

EXPORTATIONS.

To the Union of South Africa.—Oxen 21, cows 1.

To Portuguese East Africa.—Oxen 40, cows 29.

EXPORTATIONS—MISCELLANEOUS.

To the United Kingdom.—Chilled beef quarters 1,412.

To Northern Rhodesia.—Frozen beef 51,760 lbs., frozen pigs 4,312 lbs.

To Congo Belge.—Frozen beef 108,235 lbs., frozen mutton 355 lbs., frozen pigs 1,143 lbs., frozen veal 2,217 lbs.

Meat Products.—From Liebig's Factory: Corned beef 223,704 lbs., tongues 330 lbs.

G. C. Hooper Sharpe,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-38.

Monthly Report No. 63, February, 1938.

The last remaining swarms of the over-wintering adult stage of the Red Locust (*Nomadacris septemfasciata*, Serv.) appear to have died out during the first week in February.

Hatchings of hoppers, mostly on a small scale, have occurred in the following districts:—Mtoko, Mrewa, Darwin, Lomagundi, Sebungwe, Hartley, Salisbury, Mazoe, Marandellas, Umtali, Victoria, Bikita, Ndanga and Nyamandhlovu.

The hopper bands are being destroyed in all accessible localities.

The most serious outbreak in country occupied by Europeans has occurred around Concession, in the Mazoe district, but even there the hatchings appear to be relatively light and the situation is well in hand.

The baiting method of destroying hoppers developed of recent years in the Union of South Africa is being tested in the last-named locality, but the frequent rains have so far handicapped the work.

RUPERT W. JACK,
Chief Entomologist.

Departmental Bulletins.

The following Bulletins are available for distribution at 3d. per copy. Application should be made to the Editor, Department of Agriculture, Salisbury, and remittances must accompany orders.

N.B.—The date the article appeared in the Journal is indicated in abbreviated form before the number, e.g., 8/22, No. 429, means that Bulletin 429 appeared in the Journal for August, 1922.

AGRICULTURE AND CROPS.

7/25.	No. 545.	Artificial or Synthetic Farmyard Manure, by H. G. Mundy, Dip.Agric., F.L.S.
3/27.	No. 630.	The Storage of Seed Potatoes, by H. C. Arnold.
5/27.	No. 643.	Noxious Weeds in Southern Rhodesia, by F. Eyles, Botanist.
12/27.	No. 663.	The Use of Fertilisers and Manures in Southern Rhodesia, by A. D. Husband, A.I.C., Chief Chemist.
2/28.	No. 672.	Hay-making in Rhodesia, by H. G. Mundy, Dip.Agric., F.L.S.
2/28.	No. 674.	Top Dressing of Maize against Stalk Borer, by H. C. Arnold.
3/28.	No. 681.	The Sunflower (Helianthus Annuus) (Revised), by S. D. Timson, M.C., Dip.Agric.
6/28.	No. 695.	The Castor Oil Plant (Ricinus spp.), by S. D. Timson, M.C., Dip.Agric.
9/28.	No. 705.	Suggested Cropping Programmes for Farms on the Sand Veld, by D. E. McLoughlin, Assistant Agriculturist.
10/28.	No. 710.	Monthly Reminders for the Farming Year, by the Division of the Chief Agriculturist.
3/29.	No. 727.	Farmyard Manure, by A. P. Taylor, M.A., B.Sc., Agricultural Chemist.
3/29.	No. 732.	Two Common Diseases of Potato Tubers in Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.
7/29.	No. 743.	Sunn Hemp, by S. D. Timson, M.C., Dip.Agric.
9/29.	No. 751.	The Sweet Potato, by S. D. Timson, M.C., Dip.Agric. (Wye).
10/29.	No. 758.	Instructions for Taking Soil Samples. Issued by the Division of Chemistry.
1/30.	No. 768.	The Ground Nut (Arachis hypogaea), by S. D. Timson, M.C., Dip.Agric. (Wye).
3/30.	No. 776.	Regulations Governing the Export of Maize and Maize Meal through the Port of Beira.
11/30.	No. 797.	Green Manuring: An Essential Practice in Rhodesian Farming, by H. G. Mundy, Dip.Agric. (Wye), F.L.S., Chief Agriculturist.
1/31.	No. 802.	Witch Weed, by S. D. Timson, M.C., Inter.B.Sc. (Agric.) London., Dip.Agric (Wye), Assistant Agriculturist.

3/31. No. 815. New Strains of Oats for Southern Rhodesia, by H. C. Arnold, Manager, Agricultural Experiment Station, Salisbury.

4/31. No 816. Preliminary List of the more Common Grasses of Southern Rhodesia, by Sydney M. Stent, Botanist for Pasture Research.

5/31. No. 822. Re-stacking of Maize rejected for Export on account of Excessive Moisture.

9/31. No. 826. Some Poisonous Plants of Southern Rhodesia, by Sydney M. Stent, Senior Botanist.

10/31. No. 831. Revised Notes on Cotton Growing in Southern Rhodesia, by G. S. Cameron.

11/31. No. 836. The Potato, by S. D. Timson, M.C., Dip.Agric. (Wye).

12/31. No. 837. Veld Grass Silage: A Feature in Rhodesian Pasture Management, by H. G. Mundy, Dip.Agric. (Wye), F.L.S., Chief, Division of Plant Industry.

6/32. No. 855. Pigeon-hole Method of Stacking Maize, by Division of Plant Industry.

8/32. No. 859. Twenty-one Years of Plant Introduction, by Major Mundy, Chief Division of Plant Industry.

2/33. No. 878. A.I.V. Silage: Memorandum prepared and circulated by Imperial Bureau of Animal Nutrition.

11/34. No. 936. Witchweed, by S. D. Timson, M.C. Dip.Agric. (Wye), Assistant Agriculturist.

10/35. No. 970. Rhodes Grass for the Southern Rhodesian Tobacco Grower, by African Explosives and Industries, Ltd.

11/35. No. 972. Notes on Witchweed, by S. D. Timson, M.C., Dip.Agric. (Wye), Assistant Agriculturist.

6/36. No. 992. Annual Report of the Agriculturist for the year 1935, by D. E. McLoughlin, Agriculturist.

7/36. No. 994. Some Notes on Cotton Growing, by J. E. Peat, Senior Plant Breeder, Cotton Station, Gatooma.

4/37. No. 1022. Smut Diseases of Wheat in Southern Rhodesia, by G. M. Wickens, B.Sc. Agric., Ph.D., D.I.C., Plant Pathologist, Tobacco Research Station, Trelawney.

10/37. No. 1046. Green Manuring: Two Important Factors Affecting Success, by S. D. Timson, M.C., Assistant Agriculturist, and H. C. Arnold, Manager, The Agricultural Experiment Station.

REPORTS ON CROP EXPERIMENTS.

7/27. No. 649. Annual Report of Experiments, 1925-26, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Manager.

4/28. No. 683. Annual Report of Experiments, 1926-27, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Station Manager.

7/29. No. 745. Salisbury Agricultural Experiment Station Annual Report, 1927-28, by H. C. Arnold.

7/30. No. 789. Agricultural Experiment Station, Salisbury. Annual Report of Experiments, 1928-29, by H. C. Arnold.

9/31. No. 830. Salisbury Agricultural Experiment Station, Annual Report, 1929-30, by H. C. Arnold, Manager.
10/32. No. 864. Annual Report, 1930-31: Agricultural Experiment Station, by H. C. Arnold, Station Manager.
6/33. No. 895. Salisbury Agricultural Experiment Station Annual Report, 1931-32, by H. C. Arnold, Manager.
3/34. No. 914. Gwelo Municipal Demonstration Station: Final Report, 1933, by S. D. Timson, M.C., Dip.Agric. (Wye), Assistant Agriculturist.
9/35. No 965. Salisbury Agricultural Experiment Station Annual Report, 1933-34, by H. C. Arnold, Manager.

TOBACCO.

8/26. No. 605. Flue-curing Tobacco Barns, Bulking and Grading Sheds, by P. H. Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.
9/26. No. 615. The Culture of Virginia Tobacco in Southern Rhodesia: Field Management, by D. D. Brown.
5/27. No. 641. The Handling, Grading and Baling of Cured Virginia Tobacco, by D. D. Brown.
5/27. No. 644. Tobacco Baling Boxes, by B. G. Gundry, Irrigation Branch.
9/27. No. 653. The Care of Tobacco Seed Beds, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad)
11/27. No. 661. Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16 ft., by B. G. Gundry.
1/28. No. 665. Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.
2/28. No. 671. Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.
12/28. No. 715. Turkish Tobacco Culture in Southern Rhodesia, by D. D. Brown, Chief Tobacco Expert.
3/29. No. 728. Suggested Crop Rotations for Tobacco Growers, by D. D. Brown, Chief Tobacco Expert.
4/29. No. 734. Common Faults in Curing Virginia Bright Tobacco, by D. D. Brown, Tobacco and Cotton Expert.
8/29. No. 748. Frog Eye Disease of Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
9/29. No. 753. Leaf Spotting of Tobacco caused by Mosaic, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
2/30. No. 771. Dark Fire-cured Tobacco: Field Operations, by D. D. Brown, Chief Tobacco Expert.
3/30. No. 774. Dark Fire-cured Tobacco: Harvesting and Curing, by D. D. Brown, Chief Tobacco Expert.
6/30. No. 784. Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.
3/31. No. 812. Selection of Tobacco Seed Plants, by H. F. Ellis, M.Sc., B.S. (Agric.), Tobacco Adviser.

11/31. No. 835. Tobacco Culture: Transplanting Operations, by D. D. Brown.

3/32. No. 846. Leaf Curl in Tobacco, by Dr. H. H. Storey.

3/33. No. 885. Tobacco Culture in Southern Rhodesia: The Harvesting and Curing of Virginia Tobacco, by D. D. Brown, Chief Tobacco Officer.

8/36. No. 996. The "Gundry" Tobacco Furnace, by B. G. Gundry, A.I.Mech.E.

12/36. No. 1009. Tobacco Research on the Trelawney Station 1935-36 Season.

4/37. No. 1025. Report of the Tobacco Research Board, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture and Chairman of the Tobacco Research Board.

5/37. No. 1026. Notes on Tobacco Root-Knot Nematode, by J. C. Collins, B.Sc., Biologist, Trelawney Tobacco Research Station.

8/37. No. 1039. Some Tobacco Pests that can be serious, by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.

1/38. No. 1054. Alkalinity of Tobacco Seed-bed Soils, by A. P. Taylor, M.A., B.Sc., Agricultural Chemist.

3/38. No. 1063. A New and Serious Disease of Tobacco in Southern Rhodesia, by G. M. Wickens, Ph.D., D.I.C., Plant Pathologist, Tobacco Research Station, Trelawney.

LIVE STOCK.

1/27. No. 624. The Construction of Dipping Tanks for Cattle (Revised).

1/31. No. 801. Sheep Farming in the Melsetter District, by J. C. Kruger, Part-time Sheep Adviser in the Melsetter District.

10/32. No. 863. Piggeries, by B. G. Gundry, A.I.Mech.E.

12/32. No. 871. Some General Observations on the Feeding of Dairy Cows on a Mixed Stock Farm, by Dr. A. E. Romyn, Senior Animal Husbandry Officer.

1/33. No. 873. The Hand-rearing of Calves, by C. A. Murray, B.Sc. (Agric.), M.Sc.

4/33. No. 887. The Type of Chiller Steer required for Export, by A. E. Romyn, Senior Animal Husbandry Officer.

5/33. No 891. Fattening Bullocks for Export, by A. E. Romyn, Senior Animal Husbandry Officer.

9/33. No. 903. The Handling, Preparation and Chilling of Cattle for Export, by C. A. Murray, Lecturer in Animal Husbandry.

12/33. No. 907. The Blackhead Persian: Its Breeding and Management in Matabeleland, by C. A. Murray, M.Sc., Lecturer in in Animal Husbandry, Matopo Estate.

1/34. No. 909. Stall Fed Chillers for the Overseas Christmas Market, by C. A. Murray, M.Sc., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.

2/34. No. 912. Economical Winter Rations for Wintering Dairy Heifers, by C. A. Murray, M.Sc. (Agric), Lecturer in Animal Husbandry, Matopo School of Agriculture.

4/34. No. 916. Cowpea Hay in the Ration for Bacon Pigs, by C. A. Murray, M.Sc. (Agric.), Lecturer in Animal Husbandry, Matopo School of Agriculture and Experiment Station.

5/34. No. 919. Saltbush: A Winter Succulent for Sheep in Matabeleland, by D. G. Haylett, M.Sc., Ph.D., Director, Matopo School of Agriculture.

6/34. No. 924. Raising Dairy Calves on a Limited Amount of Whole Milk, by C. A. Murray, M.Sc., Agr., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.

1/35. No. 943. Cattle Improvement and a Cattle Breeding Policy in Southern Rhodesia: A Review of the General Position Chiefly as regards Ranching Cattle, by Dr. A. E. Romyn, Chief Animal Husbandry Officer.

1/35. No. 945. A Home-made Cow Stanchion, by Major R. R. Sharp, Whinburn, Redbank.

3/35. No. 946. Economical Rations for Wintering Dairy Cattle, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station.

5/35. No 952. Annual Report of the Chief Animal Husbandry Officer for the year ending 31st December, 1934, by A. E. Romyn, Chief Animal Husbandry Officer.

7/35. No. 959. The Selection of a Dairy Bull, by A. E. Romyn, Ph.D., Chief Animal Husbandry Officer.

4/36. No. 984. Report on the Curing of Rhodesian Hides, by Advisory Committee on Hides and Skins of the Imperial Institute.

4/36. No 985. Export of Frozen Porkers. Third Consignment to Smithfield. Division of Animal Husbandry.

5/36. No. 987. The Curing of Hides and Skins on the Farm, by The Division of Animal Husbandry.

5/36. No. 988. Preparing Cattle for Show, by The Animal Husbandry Division.

6/36. No. 989. The Supplementary Feeding of Mineral and Protein Supplements to Growing Cattle in Southern Rhodesia and its Relation to the Production of Beef Steers, by C. A. Murray, M.Sc. (Agric.), Senior Animal Hus bandry Officer in Charge, Rhodes Matopo Estate; A. E. Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Southern Rhodesia; D. G. Haylett, Ph.D., Director, Rhodes Matopo Estate; F. Ericksen, Dip. Agric., Experimentalist.

10/36. No. 1001. The Raising of Bacon Pigs, by A. E. Romyn, Chief Animal Husbandry Officer, and C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate, with a Veterinary Section by D. A. Lawrence, Director of Veterinary Research.

9/36. No. 1000. Sheep Management on the Mixed Farm, by R. H. Fitt, Animal Husbandry Officer.

4/37. No. 1023. Cowpea Molasses Silage for Fattening Steers, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station; A. E. Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Salisbury; R. H. Fitt, Dipl. Agric., Animal Husbandry Officer, Department of Agriculture, Salisbury.

4/37. N. 1024. Comparative Feeding Value of Maize Meal and Nyouti (*Pennisetum Typhoides*) Meal for Fattening Steers, by C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E. Romyn, Chief Animal Husbandry Officer.

5/37. No. 1027. The Feeding of Phosphorus Supplements to Growing Cattle, by C. A. Murray and A. E. Romyn.

5/37. No. 1029. The Dehorning of Cattle intended for Slaughter and Export, by B. A. Myhill, Assistant Chief Veterinary Surgeon.

5/37. No. 1030. The Feeding of Different Winter Supplements to young growing steers and the effect of these supplements on the subsequent development and costs of production of the steers, by C. A. Murray and A. E. Romyn.

6/37. No. 1032. The Effects of Feed on the Firmness and Grading of Bacon Carcases, an experiment carried out by the Division of Animal Husbandry in co-operation with Mr. A. L. Millar, Estes Park, Salisbury, and Mr. Frank Neill, of Neill's Bacon Factory, Salisbury.

6/37. No. 1034. Nyouti or Munga (*Pennisetum typhoides*) as a Feed for Bacon Pigs, by C. A. Murray and A. E. Romyn.

7/37. No. 1036. Preliminary Report on the Feeding of Winter Supplements to young growing steers and the effect of supplementary feeding on the subsequent development of these animals, by C. A. Murray and A. E. Romyn.

12/37. No. 1049. The Export of Frozen Porkers: Report on Five Consignments of Porkers Exported to Smithfield, by Division of Animal Husbandry.

1/38. No. 1053. The Feeding of Sunnhemp Hay as compared with Cowpea Hay in the Fattening Ration for Bullocks, by A. E. Romyn and R. H. Fitt.

2/38. No. 1058. Pig Industry Act, 1937. Division of Animal Husbandry.

3./38. No. 1062. Protein Supplements for Fattening Bullocks, by A. E. Romyn and R. H. Fitt.

DAIRYING.

3/29. No. 730. Common Defects in Butter-making, by T. Hamilton, M.A., N.D.A., N.D.D., and J. R. Corry, B.Sc. (Agr.), Dairy Experts.

12/30. No. 799. The Objects of Ripening Cream for Butter-making, and a few Hints on Cream Production, by F. Lammas, Dairy Officer.

4/31. No. 818. Farm Butter-making. Issued by the Dairy Branch.

9/32. No. 862. Cream Cheese, by F. A. Lammas, Dairy Officer.

3/33. No. 880. Dairy Tests and Calculations, by F. A. Lammas, Dairy Officer.

5/34. No. 922. Dairy Building in Southern Rhodesia: A Small Farm Dairy, by G. B. Gundry, A.I.Mech.E.

7/34. No. 926. Dairy Buildings in Southern Rhodesia. Cow Byre—Type II., by B. G. Gundry, A.I.Mech.E.

12/34. No 937. Gouda or Sweet Milk Cheese, by F. Lammas, District Dairy Officer.

2/36. No. 977. Notes on the Feeding of Dairy Cows during the Summer Months, by A. E. Romyn, Chief Animal Husbandry Officer.

6/36. No. 990. Southern Rhodesia Milk Recording Scheme.

12/37. No. 1051. The Production and Handling of Milk and Cream, by the Dairy Branch.

VETERINARY.

10/14.	No.	191.	Scab or Scabies in Sheep and Goats, by Rowland Williams, M.R.C.V.S.
4/25.	No.	536.	Inoculation of Cattle against Redwater and Gall Sickness, by Ll. E. W. Bevan, M.R.C.V.S.
12/25.	No.	570.	The Spaying of Bovines, by G. C. Hooper Sharpe, M.C., M.R.C.V.S., and M. H. Kingcombe, M.R.C.V.S.
6/26.	No.	597.	Suspected Poisoning of Stock: The Proper Procedure, by M. H. Kingcombe, M.R.C.V.S. (Lond.), and A. W. Facer, B.A. (Oxon.), A.I.C.
12/26.	No.	618.	Notes from the Veterinary Laboratory: Quarter Evil, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.
1/28.	No.	666.	Notes from the Veterinary Laboratory: Praemonitus—Praemunitus, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.
4/29.	No.	739.	The Laboratory Diagnosis of Animal Diseases: A Note to Emphasise some Points in the Preparation and Forwarding of Specimens, by D. A. Lawrence, B.V.Sc., Veterinary Research Officer.
10/29.	No.	756.	Parasitic Gastritis of Cattle, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.
11/29.	No.	760.	A Note on Sheep Diseases in Southern Rhodesia, by D. A. Lawrence, B.V.Sc., Veterinary Research Officer, Department of Agriculture, Salisbury.
2/30.	No.	772.	Notes from the Veterinary Laboratory: Ophthalmia, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.
4/31.	No.	819.	Measles in Swine, by P. D. Huston, M.R.C.V.S.
1/32.	No.	841.	Poisonous or Suspected Poisonous Plants of Southern Rhodesia: Tulip Poisoning of Cattle, by Sydney M. Stent, Senior Botanist, and D. A. Lawrence, B.V.Sc., Veterinary Research Officer.
10/32.	No.	866.	The Treatment of Intestinal Parasites of Sheep, by J. D. Coutts, D.V.S., M.R.C.V.S.
4/33.	No.	886.	A Preliminary Note on Contagious Granular Vaginitis in Southern Rhodesia, by D. A. Lawrence, B.V.Sc., Acting Director Veterinary Research.
5/34.	No.	921.	Myiasis (Screw-Worm) in Cattle in Southern Rhodesia, by D. A. Lawrence, Director of Veterinary Research, and A. Cuthbertson, Entomologist.

IRRIGATION, WATER SUPPLIES AND SOIL EROSION.

3/27.	No.	633.	The Cost of Pumping for Irrigation, by R. H. Roberts, B.Sc. (Eng.).
4/27.	No.	640.	Levelling for Irrigation, by Dr. W. S. H. Cleghorn, M.I.Mech.E.
11/27.	No.	659.	The Hydraulic Ram, revised by P. H. Haviland, B.Sc.

11/28. No. 668. The Water Act, 1927, by C. L. Robertson, B.Sc. (Eng.), A.M.I.C.E.

1/28. No. 670. Irrigation Canals, by P. H. Haviland, B.Sc. (Eng.).

6/30. No. 786. Low Concrete Dams, by R. Hamilton Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

2/31. No. 808. The Application of Water in Irrigation, by R. Hamilton Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

3/31. No 811. Irrigation Canal Structures, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

8/32. No. 860. Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

2/33. No. 879. Conditions Governing the Hire of Government Boring Machines.

8/33. No. 900. Three Types of Water Tank, by R. H. Roberts, B.Sc. (Eng.), A.M.I.C.E., Assistant Irrigation Engineer.

6/34. No 923. Soil Eroison, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E., Irrigation Engineer (Matabeleland).

6/35. No. 956. Annual Report of the Division of Irrigation for the year ended 31st December, 1934, by P. H. Haviland, B.Sc. (Eng.), Acting Chief Irrigation Engineer.

9/35. No. 964. The Use of Ditchers for Constructing Contour Ridges, by C. Tapson, Devondale, Concession.

9/35. No. 967. How to use an Engineer's or Farm Level, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E., Irrigation Engineer (Matabeleland).

12/35. No. 973. Domestic Water Supplies and Sanitation on the Farm, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E.. Irrigation Engineer (Matabeleland).

3/36. No. 980. Results from Glenara Soil Conservation Experiment Station, 1934-35 Season, by C. L. Robertson, B.Sc. A.M.I.C.E., Chief Engineer, Irrigation Division, and A. D. Husband, F.I.C., Chief Chemist.

8/36. No. 999. Lining an Irrigation Furrow, by R. H. Roberts, B.S., A.M.Inst.C.E., Assistant Irrigation Engineer.

3/37. No. 1019. Soil Conservation, by D. Aylen, Esq., Outside Technical Assistant, and R. Hamilton Roberts, B.Sc., A.M.Iinst.C.E., Irrigation Engineer.

1/38. No. 1052 Small Earthen Storage Dams. Part I. By the Irrigation Division.

2/38. No. 1055. Small Earthen Storage Dams. Part II. By the Irrigation Division.

3/38. No. 1061. Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

FORESTRY.

1/26. No. 575. Tending of Eucalyptus Plantations, by A. S. Thornewill, B.A.

11/29. No 763. The Utilisation of Wood, by T. L. Wilkinson, M.Sc., B.Sc.F.

1/30. No. 769. The Utilisation of Wood, by T. L. Wilkinson, M.Sc., B.Sc.F.

4/30. No. 778. The Utilisation of Wood in Southern Rhodesia—Conversion and Disposal of Timber, by T. L. Wilkinson, M.Sc., B.Sc.F., District Forest Officer.

8/30.	No. 791.	The Utilisation of Wood in Southern Rhodesia: Fencing, by T. L. Wilkinson, M.Sc., B.Sc.F., District Forest Officer.
2/31.	No. 809.	Establishing Pines: Preliminary Observations on the Effects of Soil Inoculation. Issued by the Division of Forestry.
4/31.	No. 817.	The Raising of Forest Seedlings and Transplants on the Farm, by E. J. Kelly Edwards, M.A., Dip.For. (Oxon.), Acting Chief Forest Officer.
7/32.	No. 857.	Charcoal Burning on the Farm, by R. J. Allen, Forester, Rhodes Matopo School of Agriculture and Experiment Station.
11/32.	No 869.	Wind-breaks and Shelter Belts, by A. A. Pardy, B.Sc., Forestry.
1/33.	No. 874.	Tree Planting, by the Division of Forestry.
4/33.	No. 888.	The Vegetable Ivory Palm (Hyphoene ventricosa), by G. M. McGregor, B.Sc., District Forest Officer, Matabeleland.
8/34.	No. 927.	Some Facts about Tung Oil, by R. H. Finlay, B.A., Dip. For. (Oxon.), District Forest Officer.
8/34.	No. 928.	Some Trees, Shrubs, Shrubby-Herbaceous Plants, Climbers and Water Plants suitable for the Colony, by J. W. Barnes, Manager, Government Forest Nursery, Salisbury.
12/35.	No. 974.	Summary of the Annual Report of the Division of Forestry for the year 1934, by E. J. Kelly-Edwards, M.A., Dip. For. (Oxon.), Chief Forest Officer.
		Price List of Forest-tree Transplants, Ornamental Trees Shrubs, Hedge Plants, Creepers and Seeds obtainable at the Government Forest Nursery, Salisbury.
3/37.	No. 1020.	The Raising of Forest Seedlings and Transplants on the Farm, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.
10/37.	No. 1045.	Seventeenth Annual Report of the Division of Forestry for the Year 1936, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.

HORTICULTURE

4/27.	No. 637.	Harvesting, Packing and Marketing of Deciduous and Tropical Fruits, by G. W. Marshall, Horticulturist.
8/27.	No. 650.	Coffee Culture in Southern Rhodesia, by G. W. Marshall, Horticulturist.
2/29.	No. 725.	Investigations into "Collar-Rot" Disease of Citrus, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad)
3/31.	No. 814.	Avocado Growing in South Africa, by Redvers J. Blatt, B.Sc., Ph.D.
11/31.	No. 834.	Celery Culture, by G. W. Marshall, Horticulturist.
1/32.	No. 843.	Vegetable Growing in Southern Rhodesia: Onion Culture, by G. W. Marshall, Horticulturist.

2/33. No. 876. Notes on African Aloes (Parts 1-6), by H. Basil Christian, "Ewanrigg," Arcturus.

10/33. No. 905. Notes on African Aloes (Parts 7-10), by H. Basil Christian, "Ewanrigg," Arcturus.

5/34. No. 920. Citrus Fruit Growing in Rhodesia, by G. W. Marshall, Horticulturist.

5/37. No. 1028. Tomato Culture in Southern Rhodesia, by G. W. Marshall, Horticulturist.

9/37. No. 1043. The Rhodesian Home Orchard, by G. W. Marshall, Horticulturist.

ENTOMOLOGY AND PLANT PATHOLOGY.

2/13. No. 139. Termites, or "White Ants," by Rupert W. Jack, F.E.S.

6/15. No. 214. Some Household Insects, by R. Lowe Thompson, B.A.

2/21. No. 385. The Common Fruit Beetle, by R. W. Jack, F.E.S.

12/24. No. 522 Notes on the Black Citrus Aphis, by C. B. Symes.

8/25. No. 548. Insect Pests of Cotton, by C. B. Symes.

9/27. No. 653. The Care of Tobacco Seed Beds, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad).

1/28. No. 665. Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.

2/28. No. 671. Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.

6/28. No. 696. Ticks Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.

11/28. No. 714. Trap Cropping against Maize Pests, by Rupert W. Jack, F.E.S., Chief Entomologist.

12/28. No. 718. Preliminary Experiments on the Control of White Mould of Tobacco, by J. C. F. Hopkins, B.S. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

3/29. No. 732. Two Common Diseases of Potato Tubers in Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.

6/29 No. 742. What is Diplodia in Maize? An Answer to a Popular Question To-day, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

8/29. No. 748. Frog Eye Disease of Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

9/29. No. 753. Leaf Spotting of Tobacco caused by Mosaic, by J. C. F. Hopkins, B.Sc (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

9/29. No. 754. "Pinking" of Maize: Report of a Preliminary Investigation, by T. K. Sansom, B.Sc., Plant Breeder.

6/30. No. 784. Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.

6/30. No. 788. A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.

A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist. Supplement No. 1.

7/30.	No. 790.	Notes on the Control of Some of the More Important Insect Pests of Citrus in Southern Rhodesia, by W. J. Hall, Ph.D., B.Sc., Entomologist to the British South Africa Company in Southern Rhodesia.
10/30.	No. 796.	The Army Worm (Laphygma exempta, Wlk.), by Rupert W. Jack, Chief Entomologist.
11/30.	No. 798.	The Preparation of Bordeaux Mixture and Seasonal Notes on Tobacco Diseases, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.
1/31.	No. 804.	Locusts in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.
8/31.	No. 825.	Some Common Diseases of Potatoes in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), Plant Pathologist.
3/32.	No. 848.	Mycological Notes: Seasonal Notes on Tobacco Diseases: 3, Frog Eye; 4, White Mould; by J. C. F. Hopkins, B.Sc. (Lond.).
4/32.	No. 850.	Pests of Stored Tobacco in Southern Rhodesia, by M. C. Mossop, M.Sc., Entomologist.
6/32.	No. 856.	A List of Plant Diseases occurring in Southern Rhodesia, Supplement 2, by J. C. F. Hopkins, B.Sc. (Lond.), Government Plant Pathologist.
9/32.	No. 861.	Further Notes on Leaf Curl of Tobacco in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), Plant Pathologist.
11/32.	No. 868.	Cultural Methods and Tobacco Whitefly in Southern Rhodesia, by M. C. Mossop, M.Sc., Entomologist.
5/33.	No. 892.	The Tsetse Fly Problem in Southern Rhodesia, by R. W. Jack, Chief Entomologist.
5/33.	No. 893.	Experiments with Tsetse Fly Traps against Glossina Morsitans in Southern Rhodesia, by R. W. Jack, Chief Entomologist.
6/33.	No. 894.	Mycological Notes. Seasonal Notes on Tobacco Diseases. 6. An Unusual Type of Frog Eye Spotting, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.
6/33.	No. 896.	A List of Plant Diseases occuring in Southern Rhodesia. Supplement 3. (New Records for period June, 1932, to May, 1933.) Compiled by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.
7/33.	No. 897.	The Report of the Chief Entomologist for the year ending 31st December, 1932, by Rupert W. Jack, F.E.S., Chief Entomologist.
8/33.	No. 899.	The Black Maize Beetle (Heteronchus Licus Klug), by C. B. Symes.
10/33.	No. 904.	Notes on the Biology and Control of the Red Locust in Southern Rhodesia, 1932-1933. Part I.: Control of Locusts, by R. W. Jack, Chief Entomologist. Part II.: Biological Notes on the Red Locust (Nomadacris septemfasciata, Serv.), by M. C. Mossop, A.F.C., M.Sc., Entomologist.
10/33.	No. 906.	The Locust Invasion of Southern Rhodesia, 1932-33, by R. W. Jack, Chief Entomologist.
2/34.	No. 911.	Screw Worm. A Pest of Ranch Cattle in Southern Rhodesia, by A. Cuthbertson, Entomologist. Foreword by R. W. Jack, Chief Entomologist.
3/34.	No. 913.	Locusts: Instructions for dealing with Flying Swarms, by The Division of Entomology.

4/34. No. 917. The Life History of the Screw-worm Fly, by Alexander Cuthbertson, Entomologist.

10/34. No. 934. Mycological Notes. Seasonal Notes on Tobacco Diseases. 7, Spraying in Seed-beds and Lands, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

12/34. No. 938. The Destruction and Control of Locust Hoppers, by R. W. Jack, Chief Entomologist.

1/35. No. 942. Mycological Notes. Seasonal Notes on Tobacco Diseases. 8, The Mosaic Mystery. 9, Danger Points in Field Spraying, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

4/35. No. 950. The Control of Tsetse Fly in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.

4/35. No. 951. Suspected "Streak" Disease of Maize. Notice to Growers, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

6/35. No. 957. Annual Report of the Branch of Plant Pathology for the year ending 31st December, 1934, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

8/35. No. 962. The Report of the Chief Entomologist for Year ending 31st December, 1934, by R. W. Jack, Chief Entomologist.

10/35. No. 969. The Objects and Value of Seed Treatment of Maize against Diplodia, by G. M. Wickens, Ph.D. (Lond.), D.I.C., Assistant Plant Pathologist.

5/36. No. 986. Annual Report of the Division of Entomology for year ending 31st December, 1135, by Rupert W. Jack, Chief Entomologist.

7/36. No. 993. Annual Report of the Senior Plant Pathologist for year ending 31st December, 1935. Part I.: Plant Pathology. Part II.: Tobacco Research, by J. C. S. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist and Officer in Charge of Tobacco Research Station, Trelawney.

12/36. No. 1011. Tick Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist. Revised, November, 1936.

7/37. No. 1037. Division of Entomology: Annual Report for year 1936, by R. W. Jack, Chief Entomologist.

8/37. No. 1040. A Programme for the Control of Diseases of Apple Trees in Southern Rhodesia, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

10/37. No. 1047. Mycological Notes: Seasonal Notes on Tobacco Diseases. X.: Precautionary Methods in Seed-beds, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

12/37. No. 1050. An Unusual Winter Outbreak of Maize Weevil *Calandra oryzae*, L.), by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.

2/38. No. 1059. A Poison Bait for Young Locust Hoppers.

POULTRY.

1/29. No. 721. Poultry Keeping in Rhodesia: Pedigree Breeding, by H. G. Wheeldon, Assistant Poultry Expert.

4/29. No. 738. Hints to Breeders: Rearing Young Stock, by A. Little, Poultry Expert.

6/29. No. 740. Artificial Incubation, Breeding and Rearing of Chicks, by H. G. Wheeldon, Poultry Expert.

11/29. No 761. Housing and Feeding of Adult Stock, by H. G. Wheeldon, Poultry Expert.

10/30. No. 795. The Turkey, by G. H. Cooper, Assistant Poultry Officer

1/31. No. 803. Geese, by G. H. Cooper, Assistant Poultry Officer.

9/31. No. 827. The Ideal Brooder, by F. Roberts, Assistant Poultry Officer.

10/32. No. 865. Poultry Industry: Care of Young Stock in Hot Weather, by H. G. Wheeldon, Chief Poultry Officer.

11/32. No. 870. Trap Nests, by B. G. Gundry, A.I.MechE. (combined with No. 875).

1/33. No. 875. Another Trap Nest, by B. G. Gundry, A.I.Mech.E. (combined with No. 870).

3/33. No. 884. The Vitamins in Poultry Feeding, by G. H. Cooper, Poultry Officer, Matopo School of Agriculture and Experiment Station.

5/34. No 918. The Moulting of Poultry: The Normal and Pullet Moult, by H. G. Wheeldon, Poultry Officer.

10/34. No 933. Ducks on the Farm (Revised), by H. G. Wheeldon, Poultry Officer.

12/34. No. 939. The Use of Galvanised Iron in the Making of Some Appliances for Poultry Keeping, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.

12/34. No. 940. A Cheap Portable Colony House for Poultry, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.

3/34. No. 947. Modern Culling of Laying Hens, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.

9/35. No. 966. Egg Marketing Bill: Draft of a Bill having for its purpose the more orderly Marketing of Eggs.

11/35. No. 971. Feeds for Poultry and How to Use Them, by G. H. Cooper, Assistant Poultry Officer.

The following pamphlets can be obtained from the Poultry Officer upon application:—

Selecting Birds for Laying Tests, by A. Little, Poultry Expert.

Tuberculosis, by A. Little, Poultry Expert.

Prevention of Disease among Poultry, by A. Little, Poultry Expert.

Preparing Birds for Show, by A. Little, Poultry Expert.

The Fowl Tick (Argas persicus), by A. Little, Poultry Expert.

Culling: A Seasonal Operation, by A. Little, Poultry Expert.

Choosing a Male Bird, by A. Little, Poultry Expert.

The Breeding Stock, by A. Little, Poultry Expert.

Diseases of the Digestive System, by A. Little, Poultry Expert.

Mating for Improvement and Increased Egg Production, by A. Little, Poultry Expert.

Partial Moult: Broodiness. Selection of Layers of Large Eggs, by A. Little, Poultry Expert.

Exhibiting Eggs at Shows, by A. Little, Poultry Expert.

Condition of Birds on Show, by A. Little, Poultry Expert.

Green Food: The Result of not Supplying Sufficient to Poultry, by A. Little, Poultry Expert.

Good and Bad Hatching Eggs, by A. Little, Poultry Expert.

Grading Fowls, by A. Little, Poultry Expert.

Housing: Three Important Essentials, by A. Little, Poultry Expert.
Advice to Prospective Poultry Farmers, by A. Little, Poultry Expert
Seasonal Hints—August, by A. Little, Poultry Expert.
Successful Chick Rearing, by H. G. Wheeldon, Assistant Poultry Expert.
Hints to Breeders, October, by A. Little, Poultry Expert.
Abnormalities in Eggs, by A. Little, Poultry Expert.
Hints to Breeders. Prepare for the Breeding Season, by A. Little.
Respiratory Diseases, by A. Little, Poultry Expert.
Selection and Preparation of Fowls for Exhibition, by H. G. Wheeldon, Poultry Expert.
The Close of the Hatching Season and After, by H. G. Wheeldon, Poultry Expert.

12/36. No. 1010. Poultry Parasites, by H. G. Wheeldon, Poultry Officer.

METEOROLOGICAL.

12/22. No. 436. The Possibility of Seasonal Forecasting and Prospects for Rainfall Season, 1922-23, by C. L. Robertson, B.Sc., A.M.I.C.E.
12/24. No. 524. The Use of an Aneroid Barometer, by C. L. Robertson, B.Sc., A.M.I.C.E.
2/25. No. 532. The Short Period Forecast and Daily Weather Report, by C. L. Robertson, B.Sc., A.M.I.C.E.
6/25. No. 542. Review of the Abnormal Rainfall Season, 1924-25, by C. L. Robertson, B.Sc., A.M.I.C.E.
10/28. No. 712. The Time, and How to Find It, by N. P. Sellick, M.C., B.Sc. (Eng.).
10/31. No. 832. The Weather Map and the Short Period Weather Forecast, issued by the Meteorological Office.
2/33. No. 877. Clouds and Weather in Southern Rhodesia, by N. P. Sellick, M.C., B.Sc., Meteorologist.
3/35. No. 948. The Weather, contributed by The Meteorological Office.

AGRICULTURAL BUILDINGS.

9/25. No. 554. Pisé-de-Terre, by P. B. Aird.
4/26. No. 588. Concrete on the Farm, by N. P. Sellick, M.C., B.Sc. (Eng.), Assistant Irrigation Engineer.
8/26. No. 605. Flue-curing Tobacco Barns. Bulking and Grading Sheds, by P. H. Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.
5/27. No. 644. Tobacco Baling Boxes, by B. G. Gundry, Irrigation Branch.
11/27. No. 661. Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16ft., by B. G. Gundry.
10/32. No. 863. Piggeries, by B. G. Gundry, A.I.Mech.E.

5/33. No. 889. The Construction of Dipping Tanks, by B. G. Gundry, A.I.Mech.E.; and Notes on their Management, by J. M. Sinclair, M.R.C.V.S., Chief Veterinary Surgeon.

9/33. No. 902. Brick-making on the Farm, by A. C. Jennings, Assoc.M.Inst.C.E.

12/33. No. 908. A Charcoal Safe or Cooler, by B. G. Gundry, A.I.Mech.E., Irrigation Division.

5/34. No. 922. Dairy Building in Southern Rhodesia: A Small Farm Dairy, by B. G. Gundry, A.I.Mech.E.

7/34. No. 926. Dairy Buildings in Southern Rhodesia. Cow Byre—Type II., by B. G. Gundry, A.I.Mech.E.

8/36. No. 996. The "Gundry" Tobacco Furnace, by B. G. Gundry, A.I.Mech.E.

10/36. No. 1002. A Simple Farm Gate, contributed by the Division of Forestry.

8/37. No. 1041. Feeding Pens for Bullocks: the Layout at Estes Park, near Salisbury.

CHEMISTRY.

12/29. No. 762.—The Value of Rock Phosphate and "Bone and Superphosphate" as Fertilisers for Maize Production, by A. D. Husband, Chief Chemist.

4/32. No. 852. Mixing of Fertilisers: A Guide to Methods of Calculation, by the Division of Chemistry.

7/32. No. 858. The Softening of Waters, by the Division of Chemistry.

1/34. No. 910. The Toxicity to Grazing of Grass Sprayed with a Solution of Sodium Arsenite, by A. D. Husband, F.I.C., and J. F. Duguid, M.A., B.Sc.

9/34. No. 930. Analyses of Rhodesian Foodstuffs, by The Division of Chemistry.

4/35. No. 949. Report of the Branch of Chemistry for year ending 31st December, 1934, by A. D. Husband, F.I.C., Chief Chemist.

5/35. No. 954. Experiments on the Toxicity to Fowls of Arsenite of Soda and Poisoned Locusts, by J. K. Chorley, F.R.E.S., and R. McChlery, B.A., B.Sc.

4/36. No. 983. Annual Report of the Branch of Chemistry for year ending 31st December, 1935, by A. D. Husband, F.I.C., Chief Chemist.

7/37. No. 1035. Analyses of Rhodesian Foodstuffs, by The Division of Chemistry.

MISCELLANEOUS.

4/28. No. 686. The Land Bank, Its Functions and How it Operates, by S. Thornton.

4/28. No. 687. The Use of Explosives on the Farm, by P. H. Haviland, B.Sc. (Eng.).

7/28. No. 702. Book-keeping on the Farm, by T. J. Needham, Acting Accountant, Agricultural and Veterinary Departments.

9/28.	No.	707.	Wood-Charcoal in Southern Rhodesia, by T. L. Wilkinson, B.Sc., Assistant Forest Officer.
5/31.	No.	820.	The Great Economic Problem in Agriculture—No. 1, by J. R. McLoughlin, M.Sc. (Economics), Economic Adviser.
6/31.	No.	823.	The Law of Supply and Demand—No. 2, by J. R. McLoughlin, M.Sc. (Economics), Economic Adviser.
			Twelve Simple Rules for the Avoidance of Malaria and Blackwater.
			Summary of the Game Laws of Southern Rhodesia.
11/34.	No.	935.	The Weeds and Poisonous Plants of Southern Rhodesia, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture. Part I.
6/35.	No.	958.	A Cheap Levelling Device, by A. W. Laurie, Howick Vale, Concession.
8/35.	No.	961.	A Home-made Ridger. Contributed by Mr. Douglas Aylen, Somerset, Concession.
1/36.	No.	975.	Fertilizers, Farm Foods, Seeds and Pests Remedies Ordinance, 1914.
2/36.	No.	979.	The Prospects of Black Bass in the Inland Waters of Southern Rhodesia. Specially contributed.
6/36.	No.	991.	Silage and Silos.
8/36.	No.	997.	Reward Wheat: Report on the Baking Properties and Chemical Analyses, by The Rhodesian Milling and Manufacturing Co., Ltd.
8/36.	No.	998.	Summary of the Game Laws of Southern Rhodesia.
3/37.	No.	1017.	The Conditions Governing the Hire of Government Boring Machines.
3/37.	No.	1018.	Veld Fires. The "Forest and Herbage Preservation Act, 1936," by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Chief Forest Officer.
3/37.	No.	1021.	Breaking in Young Oxen to the Yoke, by J. B. West, Dromoland, P.B. Lonely Mine.
5/37.	No.	1031.	Cattle Bale or Grip.
6/37.	No.	1033.	Compost: A Note on Methods of Reducing the Costs, by S. D. Timson, M.C., Assistant Agriculturist.
7/37.	No.	1038.	Star Bur-weed (*Acanthospermum australe*, O. Kuntze), by Chas. K. Brain, D.Sc., Director of Agriculture.
8/37.	No.	1042.	Weeds of Southern Rhodesia. Part II. By Chas. K. Brain, D.Sc., Director of Agriculture.
9/37.	No.	1044.	Farming Calendar.
11/37.	No.	1048.	Compost, by S. D. Timson, M.C., Assistant Agriculturist.
2/38.	No.	1056.	Notes on the Cashew Nut. By C. K. Brain, Director of Agriculture.
2/38.	No.	1057.	The Preservation of Farm Beacons and how to make use of the Fencing Law.
2/38.	No.	1060.	How to make Tobacco-Wash on the Farm, by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.
3/38.	No.	1064.	Farm Roads, by Stuart Chandler, Chief Road Engineer.

THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.
(Assisted by the Staff of the Agricultural Department).

PUBLISHED MONTHLY.

Subscription: 5/- per annum; payable to the Accountant, Department of Agriculture, Salisbury.

VOL. XXXV.] MAY, 1938. [No. 5.

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Butter and Cheese Levies.—It should be noted that the levies imposed under Government Notice No. 895 of 1937 on butter and cheese have been withdrawn from the 15th April, 1938, until further notice.

All producers of farm butter who are in possession of butter wrappers on which the levy has been paid should retain them, or if they so desire, they may surrender them to the Secretary, Dairy Industry Control Board, P.O. Box 592, Salisbury, who will arrange for a refund of the value of the levy paid on the stamped butter wrappers surrendered.

At such time as the levy is re-imposed on farm butter manufactured in Southern Rhodesia, producers may apply to the Secretary, Dairy Industry Control Board, for the re-issue

of the surrendered wrappers, which application should be accompanied by a remittance to the value of the levy refunded by the Board.

The Central Paradox.—Taken one by one, the economic problems of agriculture yield to analysis more or less readily, though the solution remains difficult. There is no particular mystery, for example, about the origin of surpluses, about the disparities that develop between farm and non-farm prices, about the increase of tenancy, or about the conditions that promote accelerated erosion.

But taken together these problems make a total that is greater than the sum of the parts and merges with the central problem of the modern economy, which is the existence, side by side, of want and potential plenty. No one seems to know the answer. Monetary theorists, Neo-Malthusians, social reformers, and revolutionists, offer conflicting interpretations, which the older schools at least agree in rejecting.

Agriculture, though it is a principal source of food and clothing, feels the paradox cruelly. Those who work at it and produce abundance, find themselves going without, particularly when they have been exceptionally successful in getting nature to give up her treasure. American farmers grow enough for the country and something for export even in drought years; in years of normal weather they produce surpluses. The result is not plenty on the farms, in contrast to an insufficiency elsewhere. On the contrary, the farmers go short, and other people satisfy their wants at a very low cost.

When farming is too productive, farm families go hungry—literally. In this age of specialisation, farm products must usually be exchanged before they can satisfy the farm family's wants; when the goods are too plentiful, the exchange brings little in return. Wealth and poverty have rubbed elbows from time immemorial; but the contemporary phase of the conflict is novel. It is sheer inability of wealth, under certain circumstances, to do those who have produced it any good.

This problem is so obscure and difficult that little can be said about it here. One point, however, we may note. Many

persons attribute the difficulty to a disparity or lag between science on the one hand and social organisation on the other. Science, they believe, has provided the means of plenty, and it remains for politics or sociology or something not usually called science, to show how the scientific victory may be applied. But such is not the case. Science cannot be truly said to have provided the means of plenty when it has solved merely the technical problems involved. Science includes economic and social, as well as physical problems; its sphere embraces man as well as nature. Not merely production but distribution and exchange and numerous social questions fall within its scope.

Such problems are as truly scientific as the more exact problems of mathematics, chemistry, astronomy, and physics. Specialists in these fields commonly deny the name of science to economics, psychology, and politics. This is a mistake. It springs from the idea that science deals only with what can be measured. No study becomes exact, quantitative, or measurable all at once; it begins with observation, experiment, and reason. Measurement comes later. Certain problems in economics and sociology are so vital that if we do not solve them, all the rest of our science may disappear; but economics and sociology are not yet exact sciences. Further progress in the physical sciences awaits progress in the social sciences. There must be more cross-fertilisation of technical with social research, or both will come to a halt. Science must enter fields that it has not yet staked out.

The problem of coexistent want and plenty, which is utterly different to-day from what it was before the industrial revolution, is a central example of the need for a new combination of the physical and the social sciences. It becomes more and more urgent. Each advance in the technology of production enhances the difficulties of distribution and shows that one path cannot run ahead of the other indefinitely. It is time to pause, to take stock, and to see whether technology and social organisation cannot somehow be harmonised. Science has done wonders in production; but unless it achieves corresponding victories in the economic and social sphere, it will find itself in a blind alley. Its technical successes will be

misapplied or forgotten, and society will revert to more primitive forms. Already we get a hint of the possibility in a retrograde tendency in agriculture. Even in the United States the difficulties of distribution are producing less commercial and technically less efficient types of farming.—*The Response of Government to Agriculture,* U.S.A. Dept. of Agriculture.

Improved Pastures in New Zealand.—According to the Official Yearbook for 1938 grass is by far the most important crop to the farmer, since the soils, the climate and other natural conditions obtaining in the Dominion are very favourable for the growth of the grass. Wherever there is light and moisture English grasses thrive when the natural bush and fern are cleared off, and, from the mildness of the winter season, there are very few places where there is not some growth even in the coldest months of the year, enabling cattle to be kept all the year round in the open.

At the beginning of the year 1937 there were 17,509,454 acres under artificially sown grasses (including 639,632 acres cut for seed, hay or ensilage during the preceding season), and in addition 14,188,184 acres of occupied land still remained in tussock or other native grasses, making a total of 31,697,638 acres of grassland in occupation.

The total area of grasses and clovers cut for seed during the year 1936-37 was 96,577 acres, yielding 809,703 bushels of 20 lbs., as against 1,727,233 bushels from 134,405 acres in 1935-36. Canterbury, Otago, and Southland land districts between them provided 88 per cent. of the area cut.

The principal pasture plant seeds harvested included Rye-grass, Cocksfoot, Chewings Fescue, Crested Dogtail, Red Clover and Cow-grass, White Clover and Browntop.

A considerable export of grass-seed has been built up during recent years, especially with the United Kingdom, Australia, and the United States of America, the quantity exported to these countries in 1936 amounting to 74,028 cwt., valued at £229,263. The total quantity of locally-produced grass and clover seed exported to all countries amounted to 79,982 cwt., with a recorded value of £249,861.

Tobacco Growing in Australia.—Tobacco growing some years ago promised to occupy an important place amongst the agricultural industries of Australia. Thus, as early as the season 1888-89, the area under this crop amounted to 6,641 acres, of which 4,833 were in New South Wales, 1,685 in Victoria, and 123 in Queensland. This promise was, however, not fulfilled, and after numerous fluctuations, in the course of which the Victorian area rose in 1895 to over 2,000 acres, and that in Queensland to over 1,000 acres, the total area declined considerably.

In all the States in which its cultivation has been tried, the soil and climate appear to be suitable for the growth of the plant, and the large import of the tobacco in its various forms is an index of the market for a satisfactory product. The net imports for tobacco into Australia during the year 1935-36 were valued at £A1,792,544, while the net quantity of unmanufactured tobacco imported was 19,532,586 lbs., valued at £A1,931,281. The area under this crop in 1935-36 amounted to 10,538 acres, which produced 5.6 million lbs. Victoria with 5,840 acres and Queensland with 3,117 acres were the chief producing States.

It has been proved that suitable leaf can be grown, and efforts are now being directed to the elimination of disease, and to improvement in the quality and aroma of the finished product. As the result of an agreement with the Commonwealth Government, the Australian tobacco manufacturers agreed to purchase, in 1931-32, 7.2 million lbs. of suitable leaf at an average price of 2s. 3d. per lb.; actually more than 10.5 million lbs. was purchased at an average of 2s. 1½d. per lb. The agreement was not renewed and the area declined from 26,272 acres in 1932-33 to 10,538 acres in 1935-36.

In 1929 a Select Committee was appointed by the House of Representatives to report on the tobacco industry in Australia. The report of the Committee was submitted on 1st July, 1930, and among the recommendations made was one for the formation of a Tobacco Investigation Committee. This Committee was formed and was financed jointly by the Commonwealth Government and the British-Australian Tobacco Company, the company undertaking to contribute up to £3,000 on the £ for £ basis. In 1933 another Com-

mittee was appointed. The recommendation of this Committee, which reported on the 16th November, 1933, that a sum of £20,000 should be provided annually for five years to assist the States to continue economic and scientific investigations, was adopted, and this amount has been included in the Budget for each year since 1933-34. £5,000 was allotted to the Council for Scientific and Industrial Research, and the balance was distributed among the States to provide additional services, £3,750 being allocated to each of the States of New South Wales, Victoria and Queensland, and £1,250 each to South Australia, Western Australia and Tasmania. The Council for Scientific and Industrial Research is investigating diseases affecting the tobacco plant, including work on disease resisting varieties, and is making tests of smoking quality. The Council has been successful in discovering effective means of preventing blue mould, and consequently the development of the industry should proceed on much sounder lines than hitherto. The States are carrying out field investigations on disease resistance selection, yield and quality improvement, and are conducting instructional, demonstrational and field experimental work.—*Official Yearbook of Australia*, 1937.

Issue of Maize to Farmers in Drought-stricken Areas.—Relief maize will be supplied to farmers in drought-stricken areas either on terms of purchase or on loan. Conditions No. 1 to No. 7 will apply to both schemes:—

(1) In each area local Committees will be formed consisting of the Senior Government Officer with one selected local farmer or other prominent representative to examine and approve all applications. The Government Official will forward approved applications to the Maize Control Board for execution.

(2) Before relief maize can be supplied the applicant will be required to satisfy the local Committee that (1) he is not normally in the habit of purchasing maize for the feeding of his cattle or native labourers, (2) his necessity to purchase maize at the reduced price is due solely to drought conditions, (3) he planted a sufficient area of maize during the 1937-38 crop

season to provide for his usual farm requirements, and (4) he had not delivered to the Board, or otherwise disposed of any portion of his 1937-38 season's maize crop.

(3) Each approved applicant will be required to sign an undertaking to the effect that the maize supplied will not be re-sold or used for any other purpose except feeding to his livestock or native labourers.

(4) Applications must be received by the local Committee not later than the 30th June, 1938, unless the the conditions of the scheme should subsequently be extended by the Government.

(5) The maximum quantity of maize to be supplied to any applicant will be 150 bags.

(6) Only maize of classes A, A1, B, or B1 shall be supplied.

(7) Wherever possible the district official will arrange with the Control Board or the Board's local agents for the requisite supplies of maize when consigned by rail to be despatched in truck loads. District officials will forward returns at the end of each month to the Board and to the Department of Agriculture showing quantities authorised under each phase of scheme, with full name and address of approved applicant. Where a cash payment is made the money will be transmitted direct to the Maize Control Board.

Purchase Scheme—

(*a*) Maize will be supplied under the purchase scheme only to those farmers who in normal seasons do not grow more maize than they require for their own use and who therefore would be likely to have difficulty in returning maize supplied under the loan scheme.

(*b*) The price charged for the maize will be 7s. 6d. per bag, buyers' stations (Hartley, Gatooma, Que Que, Gwelo, Fort Victoria, Bulawayo, and Plumtree).

(c) The cost of the maize at the above price will be collected in cash from the applicant wherever possible. Otherwise the debt will be secured by an I.O.U. or an Acknowledgment of Debt for a period not exceeding twelve (12) months in favour of The Land and Agricultural Bank of Southern Rhodesia.

Loan Scheme—

(a) Relief maize will be supplied under this scheme to farmers who are able to satisfy the local Committee (a) that they normally grow a surplus of maize for sale, (b) that they intend to grow maize in the 1938-39 crop year, and (c) that they can reasonably expect to be able to return the maize loaned by the Control Board from their 1939 harvest.

(b) The Maize Control Board will supply the maize from any unsold stocks locally available or, failing such local supplies, from the following depots: Hartley, Gatooma, Gwelo, Fort Victoria, Bulawayo. Railage from the consigning station shall be borne by the farmer and he shall be under an obligation to return an equivalent quantity and grade of maize from his 1939 harvest, carriage paid, at the depot or place from which the loaned maize was drawn.

(c) Loan maize will not be available after the 30th September, 1938.

All applications under this scheme must be submitted to the Magistrate of the district concerned, in the first place, for consideration and not to the Department of Agriculture, the Maize Control Board or the Land and Agricultural Bank direct.

Publications of the Imperial Economic Committee.

It is thought that some of our readers may wish to obtain copies of the reports which are published by the Imperial Economic Committee. The following have been selected from the list and the prices given include postage:—

Reports No.		
4	Dairy Produce (1926)	1s. 2d.
6	Poultry and Eggs (1927)...	1s. 2d.
12	Pigs and Pig Products (1929)	8d.
16	Hides and Skins (1930)	7d.
27	Grassland Seeds (1934)	1s. 2d.
28	Maize (1934)...	1s. 2d.
31	Tobacco	2s. 2d.

SURVEYS OF WORLD PRODUCTION AND TRADE.

Cattle and Beef	5s. 6d.
Ground Nut Products	4s. 6d.

COMMODITY SERIES.

Meat (1937)	2s. 8d.
Fruit (1937)	2s. 8d.
Grain Crops (1937)	2s. 8d.
Industrial Fibres (1937)	2s. 9d.
Vegetable Oils and Oilseeds (1937)...	2s. 9d.
Dairy Produce (1937)	2s. 8d.

The Reports and Surveys can be obtained from H.M. Stationery Office, Adastral House, Kingsway, W.C.2 (and branches), or direct from the Secretary, Imperial Economic Committee, 2, Queen Anne's Gate Buildings, S.W.1.

Government Loans and Subsidies, etc.

FOR SOIL AND WATER CONSERVATION, GREEN MANURING AND ARTIFICIAL FERTILISERS.

It appears that large numbers of farmers are still unaware of the easy conditions under which loans and subsidies may be obtained and are also unaware of the conditions under which the Premier Portland Cement Company (Rhodesia) Ltd. provides supplies of cement at reduced rates for water conservation works.

It has been decided, therefore, as a result of the need for expansion of such works, stressed by the Soil Conservation Advisory Councils of Mashonaland and Matabeleland, to set out the general conditions briefly in bulletin form.

Irrigation Loans.—These loans are obtainable for any soil or water conservation works approved of by the Irrigation Department, such works including dams, weirs, canals, contour ridges and storm drains. Loans are also obtainable by Farmers' Associations or any other approved Committee or body of farmers, for the purchase of implements and plant for the construction of soil conservation works.

The application forms may be obtained either from the Director of Irrigation, P.O. Box 387, Salisbury, or from the Irrigation Engineer (Matabeleland), P.O. Box 566, Bulawayo.

Before applying for a loan it is very advisable that the scheme be first investigated by an Irrigation Engineer and farmers should apply for a visit to one of the two officials mentioned above. These visits are carried out free of charge if the time occupied by the Engineer on any one farm is not more than twenty-four hours, and if visits can be carried out during the course of a tour. Designs and estimates of costs are prepared by the Irrigation Department and the work itself pegged out, leaving the farmer in a sound position to proceed with the construction.

These loans are normally available under the following conditions:—

(*a*) Interest is charged at the rate of $4\frac{1}{2}\%$ per annum on the amount of the loan outstanding and, if desired, the interest charges over a period not exceeding the three initial years, may be funded with the loan, no repayment of capital being necessary during such period.

(*b*) Repayment of the loan and interest may be made in annual instalments over a period not exceeding 17 years, the first repayment being due not more than three years after the loan is obtained. Should a farmer be prepared to commence repayment within any period less than the first three years, the repayment period may be extended up to a maximum of 20 years.

The actual period for repayment will depend on the amount of the loan and the purpose for which it is required.

(*c*) In the case of farms which are owned by the applicant, loans are secured by registration, in the office of the Registrar of Deeds, against the title deeds of the property concerned. Such registration is not published in the *Government Gazette*.

Alternatively, these loans may be secured on the personal security of two sureties who must be holders of immovable property in Southern Rhodesia, and such sureties are insisted on if the farm is heavily bonded to a private individual.

In the case of farms held under Agreement of Purchase from the Government, security is obtained by the applicant giving written agreement that title shall not be issued until the loan is repaid in full.

In the case of Crown land farms held under lease the cost of the work will be paid for out of Government funds, provided the leaseholders agrees to having his annual rental increased by 4% of the capital outlay involved. When the farm is alienated later under Agreement of Purchase terms

the works will be regarded as a permanent improvement and their cost, plus interest at 4% per annum, will be repayable over the period of the Agreement.

(*d*) As soon as a loan is approved and the applicant is ready to commence the work, one-fifth of the loan can be paid out to him to make a start. The balance of the loan is paid out on certificates issued from time to time by an Irrigation Engineer, stating that the work is being satisfactorily carried out and that the value of the completed portions is not less than the instalments required.

(*e*) Cement required on works for which a loan has been obtained is procurable at 2s. 7d. per pocket (95 lbs.) through the Director of Irrigation or Irrigation Engineer (Matabeleland).

Tools and plant purchasable with the loan may also be obtained through these officials.

(*f*) If a loan is obtained for water conservation works, the amount which normally would be repayable may be reduced by a rebate. The conditions applying to such rebates are set out in this bulletin under the heading "Subsidies on Water Conservation Works," paragraph (*e*).

Green Manuring and Artificial Fertiliser Loans.—These loans are obtainable from the Land and Agricultural Bank of Southern Rhodesia and are made under conditions recommended by the Soil Conservation Advisory Councils. The loans are made for the purpose of meeting the cost of green manuring and fertilising of lands which have been badly eroded and which have subsequently been suitably protected by contour ridges, but which are judged to be incapable of producing a cash crop without this treatment.

Application forms can be obtained from the Land Bank, and when completed must be submitted in the first place to the Secretary, Department of Agriculture and Lands.

All applications are subsequently considered by the Finance Sub-Committee of the Soil Conservation Advisory Councils, and if recommended are then passed to the Manager of the Land Bank.

Applicants are strongly recommended to obtain, from their local Soil Conservation Committee, a brief report certifying that the lands to be treated are suitably protected by soil conservation works, and are in need of either or both green manuring and fertilising.

The conditions under which these loans are made are:—

(*a*) Loans require, in the first instance, to be recommended by an officer of the Department of Agriculture, or by the local Soil Conservation Committee, or by both.

(*b*) The loans are made on the best security available to the Land Bank, subject to the applicant being satisfactorily reported on.

(*c*) Interest is charged at the rate of 5% per annum, payable half-yearly in arrear, the first payment of interest being due six months after the date of issue of the loan.

(*d*) The capital is required to be repaid in six half-yearly instalments, the first instalment being due $3\frac{1}{2}$ years after the date of issue of the loan.

(*e*) The maximum amount of a loan in any one year for any individual farm is £100.

Subsidies on Water Conservation Works.—In order to encourage the construction of water conservation works, subsidies or rebates are granted in respect of a portion of the cost of such work.

Applications for these subsidies or rebates must be made in the first instance to the Director of Irrigation or the Irrigation Engineer (Matabeleland), as an inspection of the work by an Irrigation Engineer is necessary in order that he may submit the necessary certificate.

The conditions under which these subsidies and rebates are obtainable are as follows:—

(*a*) They will be granted only in the case of schemes involving the storage of water. They WILL NOT be granted in respect of pumping schemes, ordinary irrigation diversion schemes or schemes for the exploitation of underground water supplies.

(*b*) The amount of the subsidy or rebate is 25% of the actual cost of the storage work and is limited to a maximum of £62 10s. 0d. per individual farm.

(*c*) Subsidies or rebates will only be paid on completion of works approved by the Irrigation Department after an inspection and valuation. If the inspection is carried out by an Engineer during the course of an ordinary tour no charge is made, but should an applicant desire a special visit for the inspection, the cost of such a visit is deducted from the subsidy or rebate granted.

(*d*) Subsidies or rebates apply ONLY to approved water conservation works, which were in progress on the 1st January, 1936, or have been constructed since then.

This grant of subsidies or rebates applies only up to the 31st December, 1940, and consequently the construction of schemes by persons desirous of obtaining such rebates must be completed before this date.

(*e*) In cases where irrigation loans have been granted for the construction of storage works, the total amount of the loan, which otherwise would be repayable, will be reduced by the amount of rebate granted.

Supply of Cement at Reduced Rates.—Arrangements have been made by the Premier Portland Cement Company (Rhodesia) Ltd. whereby farmers who do not desire a loan and are willing to pay cash for the cement required, may obtain cement at reduced rates and on completion of the work will receive a rebate from the Cement Company.

The following conditions apply to obtaining cement in this manner:—

(*a*) A cheque in favour of the Premier Portland Cement Company (Rhodesia) Ltd. must first be sent to the Director of Irrigation or the Irrigation Engineer (Matabeleland).

This cheque must cover the initial cost of the cement at ordinary rate, plus railage charges if the cement is to be consigned to a siding where the sender is forced to prepay the railage charges.

If the cement is consigned to a station where prepaid railage charges are not necessary, the cement can be despatched "carriage forward" and the farmer will then have to pay the railage charges on receipt of the cement.

(*b*) The ordinary rates are 3s. 3d. per pocket (95 lbs.) for quantities less than 50 pockets, and 3s. 1d. per pocket for lots of 50 pockets and over.

The minimum quantity which can be obtained is 24 pockets—and this quantity must be on one order and in one delivery.

(*c*) After an inspection of the works by an Irrigation Engineer, a certificate is issued to the Cement Company to the effect that all the cement has been utilised in the construction of the water conservation works. The Cement Company will then forward the rebate to the farmer.

The amount of the rebate is the difference between the price initially paid and a reduced price of 2s. 7d. per pocket, thus making the actual final cost of the cement 2s. 7d. per pocket.

Loan of Ditching Implements.—Arrangements have been made whereby Farmers' Associations, approved groups of farmers or individual farmers, may obtain ditching implements on loan from the Government, free of hiring charge, for the construction of contour ridges.

The conditions under which these implements are available are as follows:—

A. *To Farmers' Associations or Groups of Farmers*:—

(1) The Farmers' Associations or group of farmers must make itself responsible for the upkeep and maintenance of the implement.

(2) The Association or group must render monthly returns in duplicate to either the Director of Irrigation or Irrigation Engineer (Matabeleland) giving the time spent and the length of ridges constructed on each farm.

(3) The Association or group is responsible for the delivery of the implement from either Salisbury or Bulawayo to its centre and for its eventual return.

(4) The choice of type of implement is left to the Association or group.

B. *To Individual Farmers*:—

(1) This shall apply only to areas in which no Farmers' Association exists.

(2) The farmer must render returns either to the Director of Irrigation or the Irrigation Engineer (Matabeleland) giving the time spent and the length of ridges constructed on his farm.

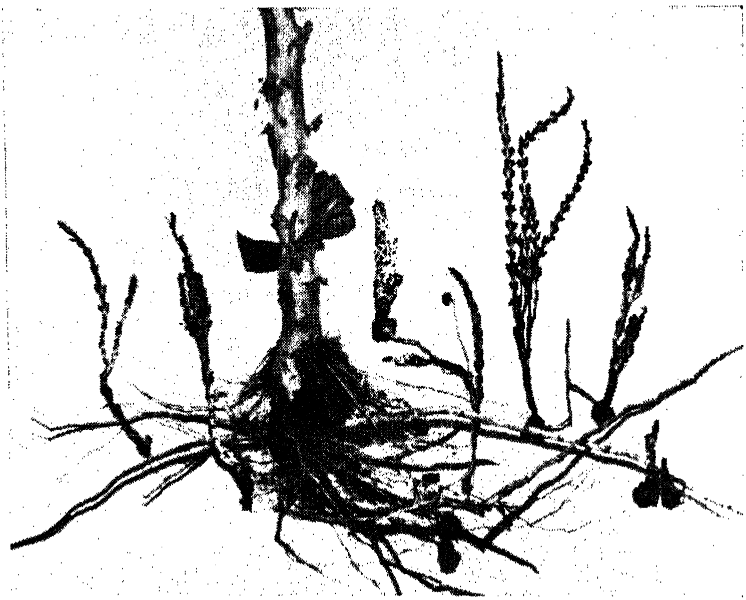
(3) The farmer must make himself responsible for the removal of the implement from Salisbury or Bulawayo and for its return in good condition, exclusive of fair wear and tear.

(4) When available, the farmer has the choice of the following implements:—

Salisbury: Lockie, Morris and Martin ditchers.

Bulawayo: Dam scraper, Martin ditcher or Morris heavy duty ditcher.

(5) The period during which an implement may be made use of by a farmer shall not exceed 14 days, unless written permission is obtained from either the Director of Irrigation or the Irrigation Engineer (Matabeleland). Such extensions will depend on the number of applications outstanding.



Witchweed on tobacco roots. Note tuberous swellings where the parasite is attached.

A Witchweed on Tobacco Roots.

(*Striga orobanchoides*, Benth.).

By CHAS. K. BRAIN, M.A., D.Sc., Director of Agriculture.

An interesting discovery was made in April this year by Mr. R. J. Tarrant, of Delta Farm, Marandellas. On a visit to his tobacco farm in the Enkeldoorn district he discovered six tobacco plants of which the roots were severely parasitised by *Striga orobanchoides*, Benth. As far as is known this is the first case reported of an indigenous witchweed attacking tobacco. Although the roots of the tobacco plant brought to this office carried more than twenty witchweed parasites, the stem was normally developed and had borne fifteen or more curable leaves. The discovery was made in the first case by noticing that a plant wilted badly, and an examination of the roots showed the presence of the large tuberous swellings where the witchweed is attached. These are well shown in the illustration.

Striga orobanchoides, Benth., is well known throughout Africa and also occurs in the Cape Verde Islands and in India. It has been recorded as a parasite on a number of legumes, including different species of Indigofera, which are common in the sandveld areas of this Colony, and also on Ipomoeas, Euphorbias, Sansevieria, Cissus, rushes, etc., It is easily recognised by its thick stems, the few short bract-like leaves and the large tuberous attachments to the roots of the host plants.

According to a description given in *The Flora of Tropical Africa*, the plant varies from 3 to 18 inches high and the flowers vary in colour from white, rose, lavender, purple or brownish red. The plants are always much branched from the base, and a single plant can produce many thousands of seeds.

next morning. In summer the solution should be made up once a week and in winter less often. It should be kept in a cool, dark place in bottles or jars with tightly fitting lids or stoppers. For use it is diluted to one part in twenty parts of water. A stronger solution, however, should be used if the powder or solution has already become stale. Ten gallons of such a diluted solution should not cost more than 3d.

Mixture No. 2 (from the *N.Z. Journal of Agriculture*).—1 lb. of bleaching powder, 4 lbs. of washing soda, 6 oz. of salt and 1 gallon of water. Dissolve the washing soda in one gallon of hot water, allow to cool and then add the salt and bleaching powder. Stir the solution at frequent intervals for an hour, close and leave to stand. When the solution is clear, pour it off into a dark glass or earthen jar, cork firmly and keep in a cool place. For disinfecting utensils, half a pint of the solution is used to four gallons of water. Make a fresh mixture every week.

Sodium hypochlorite is more stable but also loses chlorine. Fresh solutions must therefore be made, but not as often as in the case of bleaching powder. It is usually sold in the form of liquid containing about ten per cent. of chlorine. For use, one ounce (*i.e.*, 1 tablespoonful) is added to ten gallons of water, or a dessert spoon full to four gallons of water.

"Chloramine T" is more stable than any of the other compounds, and in powder form it contains 12.5 per cent. chlorine. Effective disinfection is obtained with one ounce to ten gallons of water.

With a view to determining the value of home-made solutions as disinfectants, a number of pails and cans were first thoroughly washed with cold water and then with water at 160° F. Two hours later the cans were rinsed in separate pairs for one minute with half a gallon of each of the disinfectants mentioned above, while, as a control, one pair was rinsed with clean water. The cans were left upside down for half an hour, after which equal quantities of sterile water were poured into each pair. The number of bacteria in specimens of the water was then determined. The average results of the four tests are given hereunder:—

Control (not disinfected)—1,634 bacteria per c.c.; fresh home-made mixture No. 1—full strength 15, half strength 27, 1/10th strength 36, 1/20th strength 40 bacteria per c.c.; fresh home-made mixture No. 2—½ pint to 4 gallons 176, ½ pint to 2 gallons 40 bacteria per c.c.; chloramine T 48, and sodium hypochlorite 27 bacteria per c.c.

From the above it is clear that the disinfectants reduced the quantity of bacteria in the utensils by more than 90 per cent. The large number of bacteria in the first case proves that washing with hot water in the ordinary way is not effective.

It must be clearly understood that chemical disinfectants have no value when used on dirty utensils. Chlorine destroys bacteria when it comes into direct contact with them, but bacteria which are protected by a layer of fat or curdled milk are not destroyed. Before treatment, therefore, the utensils must be washed and scoured well. The utensils should be disinfcted immediately before use—pails and can should be rinsed out and the liquid allowed to flow through and over the separator and other apparatus, while the rest of the solution may be used for washing hands and udders and also tables and floors. It must also be borne in mind that when disinfectants are used, more care should be taken in connection with general cleanliness in the dairy in order to obtain satisfactory and profitable results.

In view of the poisonous nature of the chemicals, the solutions should always be used in diluted form as described above, and care must be taken to destroy the sediment.—(D. T. van Rooyen, Union of S.A. Dept. of Agr. Press Service.)

Report of the Tobacco Research Board

FOR THE YEAR ENDING DECEMBER 31st, 1937.

By CHAS. K. BRAIN, M.A., D.Sc., Director of Agriculture, and Chairman of the Tobacco Research Board.

Research Board.—The original Board was appointed for a period of two years from 1st June, 1935, and the same Board was re-elected under Government Notice No. 385 for a further period of two years from 1st June, 1937. At the first meeting of the newly-elected Board held on July 27th, 1937, Dr. C. K. Brain was re-appointed chairman.

Towards the end of the year the Government decided to introduce legislation during the 1938 session to increase the administrative powers of the Board so as to make that body completely responsible for all matters connected with the staff, buildings and financial matters necessary for tobacco research. It is understood that the legislation necessary to effect these changes will be introduced at the next session.

Meetings, etc.—Nine regular meetings were held during the year, six of which took place at the Trelawney Station.

Buildings, etc.—Three sets of individual quarters, four 12 ft. x 12 ft. x 18 ft. tobacco barns and an additional 30,000 gallon brick tank were completed during the year.

The chemistry laboratory was not completely equipped until September, and the Board wishes to express its appreciation to the Chief Chemist of the Department of Agriculture for providing accommodation and equipment in his laboratories to enable Mr. Murray, Chemist on the Trelawney staff, to carry out his duties until the laboratory on the Trelawney Station was completed.

Staff.—Mr. H. F. Ellis has acted as officer in charge of the Station during the whole year. Mr. J. C. Collins,

Biologist, resigned from the Station staff in June to assume duty as Assistant Tobacco Officer in the Department of Agriculture. Although the post of Biologist was advertised in the South African and Rhodesian papers, no suitable applications were received, and it was not possible to fill the post until December, when Mr. J. W. H. Hovy took up his duties at Trelawney.

1936-1937 SEASON.

Tobacco Culture Experiments.—*Tobacco growers are warned against accepting the results of experiments recorded in this report as recommendations by the Tobacco Research Board for adoption as the general practice in this country. When such results have been definitely confirmed they will be given as a recommendation.*

General Conditions.—Good planting rains fell at Trelawney from 13th to 17th November, but unfortunately these were followed by a dry period which lasted until the 8th December. From this latter date excellent growing conditions prevailed until 25th January, when a wet spell set in and lasted until 24th February. During this period no less than 17 inches of rain fell. As a result much of the tobacco was thin and lacking in body. Owing to the heavy rains it is probable that a considerable amount of fertiliser was leached from the soil so that the tobacco ripened very quickly and increased the curing difficulties owing to the limited barn accommodation. The difficulty should not be experienced in future as four additional barns have been provided.

Disease.—Frog-eye and barn spot were particularly prevalent and were intensified by the picking conditions mentioned previously. It was found that when leaves were picked rather on the green side the amount of spot was definitely less, and the amount developing in the barns appeared to be reduced when yellowing was carried on at 100° F.

Mosaic was not nearly so prevalent as during either of the two preceding years.

Experimental Seed-beds.—The rate of seeding was 4-5th of a teaspoon of seed per 25 square yards of seed-bed. As far as the Trelawney Research Station is concerned, this is consi-

dered to be still a little too high. Observation of the germination of the seed-beds has again confirmed the fact that it is not wise to get the soil in too fine a tilth. Where this is done a certain amount of wash always occurs and the seedlings are too thick in some parts and too thin others.

Spacing Trials.—The spacing trials which have been carried out during the last two seasons were re-arranged during last season in order to eliminate the possibility of competition for fertiliser. Each plant received a standard application, the amount per acre proportionate to the number of plants. Thus the plots spaced 3 ft. x 3 ft. received 200 lbs. per acre and that spaced 3 ft. x 2 ft. 300 lbs. of 18—6—8 fertiliser.

A fresh series was laid down in which all the plots received the same quantity of fertiliser. This was to determine which spacing gave the best financial return with a standard dressing of fertiliser. A third series was laid down to test three varieties commonly grown in the country and two different fertiliser treatments and four spacings.

The wide spacings which have been included in previous experiments were eliminated as they were not found to be beneficial.

Spacings used this season were:—

(1) 3 ft. x 2 ft.
(2) 3 ft. x 2 ft. 6 in.
(3) 3 ft. x 3 ft.
(4) 3 ft. 6 in. x 1 ft. 6 in.
(5) 3 ft. 6 in. x 2 ft.
(6) 3 ft. 6 in. x 2 ft. 6 in.
(7) 4 ft. x 1 ft. 6 in.
(8) 4 ft. x 2 ft.
(9) 4 ft. 6 in. x 1 ft. 6 in.

In the first series the three spacings giving the best returns, *i.e.*, in £ s. d. per acre were 3 ft. 6 in. x 1 ft. 6 in., 3 ft. x 2 ft. and 4 ft. 6 in. x 1 ft. 6 in. In the second series the best financial return was given by the 3 ft. 6 in. x 1 ft. 6 in., 4 ft. x 1 ft. 6 in. and 4 ft. x 2 ft. It should be noticed, however, that judged on the value per pound of cured leaf

instead of total return per acre the wider spacings had the advantage, as the four plots giving the highest prices per pound were spaced 3 ft. 6 in. x 2 ft. 6 in., 4 ft. x 2 ft., 3 ft. x 2 ft. 6 in. and 3 ft. x 3 ft. In the third series the three varieties used were White Stem Orinoco, Willow Leaf and Jamaica Wrapper.

The four spacings used in each case were 3 ft. x 3 ft., 3 ft. x 2 ft. 6 in., 3 ft. 6 in. x 2 ft. 6 in. and 4 ft. x 2 ft. Half the plots received 200 lbs. of No. 4 (bloodmeal) fertiliser and the others 300 lbs. Jamaica Wrapper and Willow Leaf gave better returns than White Stem Orinoco. Although the 300 lbs. fertiliser plots gave a greater value per acre than the 200 lbs. plots the price per lb. was lower. In this series the 3 ft. x 3 ft. spacing gave the highest return per acre.

Topping Trials.—The three varieties used in the complex spacing trials were used in topping trials in which two heights of topping, *viz.*, 12 and 14 leaves and three stages of topping were included. The three stages of topping were the same as in previous years, *viz.*:—

(1) Early bud (no flowers open).

(2) Early flower (three or four flowers open).

(3) Full flower.

The season was not favourable for obtaining the best results from this experiment, but the results obtained in previous years were confirmed, *i.e.*, high topping at the early bud stage gave the best results.

Time and Method of Application of Fertiliser.—Six treatments were tested as follows:—

1. Broadcast before planting.
2. Fertiliser distributed in circle round plant before planting.
3. Half fertiliser drilled in row before planting and half applied as side dressing three weeks after planting.
4. Half fertiliser distributed in circle before planting and half as side dressing three weeks after planting.

5. Half broadcast before planting and half as side dressing three weeks after planting.
6. All applied around the plant three weeks after planting.

The series did not grow out too well as it was situated on a rather poor somewhat washed sand. The general stand was poor and only price per lb. was significant. This was the highest when the fertiliser was broadcast before planting, but the highest return per acre was obtained this season when half the fertiliser was drilled in the row before planting and half applied three weeks after planting.

Priming Trials.—The priming trials this season were unsatisfactory owing to the severe wash and poor growth. The best results were obtained where the plants were primed at three weeks and then to four to six inches at the time of topping.

Rotation Trials.—As none of these perennial grass crops has yet reached the stage of replacement by tobacco the result of annual crops only were tested. From the point of view of yield and value the best results were obtained from tobacco following Proso millet, kaffir corn and munga. Price per pound was highest where tobacco followed Proso millet, Boer manna and cotton. The value and yield were lowest where the tobacco followed legume crops such as velvet bean, dolochos bean and soya bean. Cutworm damage was particularly bad following a legume crop.

PLANT BREEDING. (Dr. A. A. Moffett.)

General.—During the season 1936-37 the programme of plant breeding was divided into the following sections:—

(*a*) Selections within varieties.

(*b*) Variety trials, comparing seven varieties which showed promise during the previous season.

(*c*) Breeding for mosaic resistance and intervarietal crosses.

(*d*) A preliminary survey of varieties imported from the United States and Canada.

(*e*) Cytological investigations.

In spite of somewhat adverse weather conditions the experiments on the whole yielded satisfactory results, and provided a very good basis for future work. The experience gained during the last season suggested considerable modifications in the design of one or two of the experiments, especially in the case of the trial of a progeny from single plant selections.

A.—Selection within Varieties.—During the previous season seven of the most promising varieties or strains were taken as forming the most favourable basis for future selection work. A varying number of single plant selections were made within each of these varieties, in all a total of 36 plants being selected. The varieties and the numbers of single plant selections in each (in brackets) are given below. The letter A or B after a variety indicates selections from different strains of the same variety.

White Stem Orinoco	A	(4)	Cash	(1)
White Stem Orinoco	B	(5)	Bononza (Canada)	(3)
Willow Leaf	A	(2)	Gold Dollar	(5)
Willow Leaf	B	(2)	Yellow Mammoth	(4)
Jamaica Wrapper	A	(8)		
Jamaica Wrapper	B	(2)		

The progeny from each single plant selection was grown in duplicate observation plots, one series of plots being on new land and one on second year land.

The plots on new land were very well grown out and the stand good, while on second year land the growth was uneven, and the stand poor. Owing to excessive rain causing premature ripening and the consequent insufficient barn accommodation a considerable amount of leaf had to be discarded from the second year land plots. It is possible that this had a differential effect on the final yields, since an early ripening plot would suffer disproportionately from delayed reaping. Most of the observations have therefore been confined to the series on new land where growth was much more uniform.

Difference between varieties were very marked in some cases, but differences between selections within a variety not being of the same order of magnitude tended to be masked by soil effects.

White Stem Orinoco A gave a rather poor yield of thin bright leaf typical of the strain grown on this Station. The B strain on the other hand gave a long leaf with good body and shape. This strain was selected originally from a wide ruffle type of plant mentioned in last year's report on a basis of its well shaped leaves and habit of carrying large leaves well up the stalk. The leaf number is lower than A strain in spite of which yields up to 1,000 lbs. to the acre were obtained from some of the selections. The body and quality of the leaf from some of the selections in the B strain were very good, although the colour was not so bright as A.

Two plots of Willow Leaf A both gave yields of long leaf. No striking differences were observed between these two selections. The B strain had a very low leaf number and did not produce very good quality leaf. This strain is being discontinued. No outstanding differences occurred between Jamaica Wrapper selections. The plots on the whole gave good yields and good quality leaf. Two plots appeared to be running to the thin flaring type of leaf, so no further selections have been made in these.

The three plots of Bonanza (Canada) were outstanding in having a price per pound almost a penny higher than any of the other plots. The yield was rather low, but this was almost certainly due to part of these plots striking across a gravelly piece of soil in which the plants made no growth.

The yield from Gold Dollar was good, and the price per pound high. Differences were observed between the selections in this variety, and it was found that these differences tended to follow the characteristics of the parents, especially as regards the colour of the cured leaf. In two plots derived from plants selected last year as being more orange in colour than the others, the general run of tobacco was definitely more orange than the remaining three plots.

Yellow Mammoth grew out well, but the quality of the leaf was very inferior. This variety also showed up badly in the variety trials, and further selections will not be made in it.

Method of Selection.—The methods for selection outlined in last year's report were continued. Photographs were taken of typical plants and leaves to serve as a permanent record of

the types. All plants bagged for seed were reaped, the leaf from each individual plant and reaping being labelled. In all, about one thousand plants were reaped in this way, and the final selections made on the cured leaf. The variation between individual plants in a plot was most striking, particularly as regards such characteristics as colour, elasticity and ability to retain condition. It is evident that although tobacco varieties may be moderately uniform in habit of growth, etc., they are far from uniform as regards the qualities of the cured leaf. A large number of plants could be eliminated immediately on the grounds of thin leaf, brittleness or excessive sponging, etc. From those which remained final selections were made of the plants which combined good texture, body and general cleanliness of the leaf, with a good leaf shape and a high yield. In the final selection only 36 plants were retained.

The great variation between leaf of the individual plants shows clearly the necessity for basing selection work on cured leaf characteristics. A number of types which might otherwise be selected can be eliminated on these grounds alone, while measurements and leaf counts on the remaining types are more accurate and less laborious when performed in the grading shed.

The results from last year's selection on this basis are of interest. In many cases the characteristics of the cured leaf of the progeny resembled those of the parent selected. This type was especially noticeable in the orange type of Gold Dollar, and in Bonanza, where one plant selected for general clearness and brightness of the leaf, gave the best quality of any plots in the series in its progeny.

Comparisons of the Progeny from Single Plant Selections.—It has been mentioned previously that in observation plots the lesser differences such as are likely to occur between progeny of single plant selections within a variety tend to be obscured by variation due to soil differences. Since the aim of plant breeding is to obtain a progressive gradual improvement by selection of better types arising by segregation or recombination of factors already present in the heterozygous condition, it is essential that as accurate a comparison as possible should

be obtained between types. It is of great importance, therefore, to distinguish genetic or inate variability from variability due to environmental conditions, such as soil differences, and to make the distinction is one of the major difficulties with which the plant breeder has to contend. Since environmental factors such as soil heterogeneity or other positional effects cannot be controlled, it is essential that an experimental design of such a type be adopted that the uncontrolled factors are equalised or distributed at random through the experiment, so that they affect all the progenies to an equal degree. This end can be obtained by use of a randomised and replicated layout. Randomised layouts have for the most part only been used in plant breeding as a means of testing the end products of selection work, but there seems to be no reason why such an experimental design should not be applied to progeny tests with beneficial results. The advantages of such a test are obvious. It is possible to draw direct an accurate comparison between the strains concerned and to abolish much of the guesswork which must necessarily accompany selection work on single observation plots. As soil and other environmental variations are largely equalised for every strain or progeny, it is possible to obtain data on the genetic variability, incidence of disease, stand, etc., and to test the significance of the results by statistical methods.

Variety Trials. Material and Methods.—The following varieties were tested:—

a. Bonanza (Canada)
b. White Stem Orinoco B.
c. Willow Leaf
d. Yellow Mammoth
e. Gold Dollar
f. Jamaica Wrapper
h. White Stem Orinoco A.

White Stem Orinoco A is the standard strain grown on this Station, and B is a selection from it.

The trial was laid down in two Latin squares, one square (A) being on new land and the other (Z) on second year land. The plots were 1/40 acre in area, excluding an edge row which was reaped separately and not included in the yield totals. The spacing within plots was 3 ft. x 3 ft., a six foot path being left between each plot.

In square A the stand was good (92%), and the growth fairly even, in spite of the fact that the plants did not grow out as well as expected. Square Z was much more irregular and the stand not so good (83%). Unfortunately, a considerable amount of leaf had to be discarded from the earlier reapings owing to no barn accommodation being available. The delayed reaping in square Z is undoubtedly one of the major factors causing the differences in yield between the two squares.

Discussion of Results from Square A.—On the basis of yield per acre and value per acre, Jamaica Wrapper and Bonanza showed up better than the other varieties. Jamaica Wrapper gave a higher yield than Bonanza, but the difference did not reach the level of significance. On the basis of value per acre, Bonanza by virtue of its higher price per pound approached very closely to Jamaica Wrapper. These differences are shown more clearly on percentages. Jamaica Wrapper gave 9.1% higher yield than Bonanza, but on value per acre the difference was only 2.3%. A similar type of difference occurred between White Stem Orinoco A and Yellow Mammoth. Compared with better varieties, White Stem Orinoco A was disappointing, and for a standard variety showed up poorly. Yellow Mammoth showed up badly on all counts—yield per acre, value per acre and price per pound. Bonanza, on the other hand, was outstanding in having a significantly higher price per pound than any other variety.

Discussion of Results from Square Z.—The differences between varieties in this square were not so striking. The poorer soil, stand and delayed reapings have had their effect and the errors of the experiment were much higher than in square A. White Stem Orinoco A was again poor compared with the other varieties. Gold Dollar dropped badly in yield in this square, while White Stem Orinoco B and Yellow Mammoth and Willow Leaf all showed increased yields compared with the other varieties. Jamaica Wrapper and Bonanza, although not keeping up the high standard they reached in square A, still came near the top of the list. Bonanza gave the best results on a price per pound basis, although in this square the difference was not significant. Yellow Mammoth again gave a significantly lower price.

Mosaic Resistance.—N.B.—*Tobacco growers should note that Ambalema was imported because of its mosaic resistance, but it is quite useless as a commercial variety.*

This experiment was put down in randomised blocks, each block consisting of five plots, *viz.*, White Stem Orinoco, Jamaica Wrapper, Ambalema, Ambalema x White Stem Orinoco and Ambalema x Jamaica Wrapper. Each plot consisted of two rows of 60 plants, rows being spaced 6 ft. apart in order to prevent leaves overlapping and the consequent spread of infection. A randomised layout was used in order that data as to height,. time of flowering, etc., could be collected without being unduly affected by soil differences. As soon as the plants were well set, one row from each plot was inoculated with mosaic. White Stem Orinoco, Jamaica Wrapper and the two F.1. hybrids showed 100% infection after one inoculation, but Ambalema showed no signs of having taken the disease. On White Stem Orinoco and Jamaica Wrapper the effect of the mosaic was very severe. At an early stage the plants developed the usual mosaic mottling, which was followed by severe blistering and distortion of the leaves. At this stage the inoculated plants were very stunted compared with the non-inoculated. As the plants approached maturity the infected plants grew to approximately the same height as the others, but the general habit was much less robust and the leaves thinner. It is evident that mosaic infection causes a very great decrease in the yielding power of the plant. Ambalema showed no signs of infection —not even a slight mottling being observed. The inoculated rows grew just as vigorously as the non-inoculated. The two crosses Ambalema x Jamaica Wrapper and Ambalema x White Stem Orinoco both showed 100% infection, but the symptoms of the disease were strikingly different from those in Jamaica Wrapper and White Stem Orinoco. At first the mosaic had a stunting effect, and the inoculated rows lagged behind the non-inoculated. Later, the infected plants grew out, and finally became as robust as the others. The mosaic produced a mottled effect on the leaf, but in no case was distortion or blistering observed. Much of the mottling also disappeared as the plants reached maturity. The F.1. hybrid is apparently intermediate between the parents as regards resistance.

Cured leaf from the hybrids proved to be more or less intermediate between the parents. Ambalema cured out green and the body was very thin. The leaf would not hold condition and became brittle very quickly. The leaf from the hybrid had a greenish cast, but as regard body and texture, was much nearer Jamaica Wrapper or White Stem Orinoco. It is difficult at this stage to foresee how the inheritance of mosaic resistance will run, but this line of work shows definite promise.

Cytology.—Following up the cytological observations made during the previous season, the following varieties and crosses between varieties were studied in greater details:—

White Stem Orinoco
Jamaica Wrapper
Vumba
Ambalema

Jamaica Wrapper x Ambalema
Vumba x White Stem Orinoco
Vumba x Ambalema

A considerable amount of material was examined of each, and in every case unpaired fragments and chromatin bridges were observed, indicating the presence of a considerable degree of structural hybridity in tobacco.

From the purely practical point of view structural hybridity means that the chromosome sets on which the factors determining the characters used for selection are placed, are not constant, but by different types of pairing, different chromosome sets are constantly being formed. Many of these sets are undoubtedly eliminated, but others set up an internal hybridity or variation, which cannot be eliminated by selection. This inconstancy of the chromosome sets probably accounts for the aberrant types constantly appearing in tobacco in spite of years of inbreeding and selection.

Any selection work must be continuously pursued, and as a pure strain cannot be obtained, it is necessary that the types of any strain be selected carefully and continuously.

PLANT PHYSIOLOGY. (H. C. Thorpe, M.Sc.).

1. **Field Observations.**—Field observations on the growing plant are of great help in supplementing tables of figures concerning crop yields, values and so on. In many cases they provide a key to the interpretation of results.

During the growth of the tobacco crop notes concerning the state of growth, vigour and general appearance of the experimental plots were taken and development data secured. Details will not be given here, but certain points will be dealt with more fully during a discussion of the experiments.

2. **Mixing and Application of Fertilisers.**—The various manurial combinations applied in the fertiliser trials were well mixed up with air-dried sand and broadcast at 1,000 lbs. per acre. Evenness in distribution was effected by the division of the whole into a number of sub-lots.

3. **Field Lay-outs and the Interpretation of the Results.**—All experiments were laid down according to some form of modern field lay-out, from which it is possible to analyse the results statistically. These designs are stated more fully under the trials concerned. Edge rows have been included in all the work and have been discarded at harvest. The advisability of including edge rows was apparent from observations taken on last season's tobacco of the variability existing between the main plot and the rows bordering pathways.

Notes on the interpretation of results were included in the report for 1935-36 and will not be repeated here.

4. **Seasonal Conditions.**—A note on the weather conditions as affecting crop values would not seem out of place. The price per pound of the tobacco was seen to exhibit remarkable uniformity from treatment to treatment, far less variability being observed than would be expected from a study of the experimental differences. From observation at grading it now is apparent that a great deal, at any rate, of the lack of price differences was undoubtedly due to the excessive spottiness of the leaves which tended to reduce all the tobacco to a common low level. For this reason crop return follow very closely the yields of marketable leaf; in a season in which more favourable climatic conditions are experienced during ripening it may be expected that the price differences and values obtained will be enhanced.

In this instance the excessive and daily rainfall experienced in February is held to be responsible for the narrow margin of price variability.

The Effect of Phosphorus, Nitrogen and Potash upon the yield, price and total value in Tobacco.

Object.—To test the response of the tobacco plant to increasing quantities of the three primary manurial ingredients—phosphorous, nitrogen and potash. This response will be measured as (1) yield of cured marketable leaf, (2) price per pound of the cured product as an index of quality, and (3) total value realised per acre.

Experimental Design.—The trial was laid down as a partially confounded incomplete block layout in twelve randomised blocks with four replications.

Manurial Treatments.—Three levels of each manurial ingredient were chosen. The first or lowest level was given by the present Rhodesian fertiliser with somewhat less phosphorous. The highest level was that reported from the United States to be in fairly general use, whilst the second level was exactly intermediate between the two.

Nitrogen was supplied as one-third ($\frac{1}{3}$), bloodmeal two-thirds ($\frac{2}{3}$), ammonium sulphate and the potash as one-third ($\frac{1}{3}$) chloride, and two-thirds ($\frac{2}{3}$) sulphate, as in this Colony. The mixtures are, therefore, combined into twenty-seven treatments as follows:—

Lb. Phosphorous per acre, Lb. Nitrogen per acre.

Lb. Potash per acre.

	(as P205)	(as N.)	(as K20)
3rd Level	80	36	80
2nd Level	52	24	48
1st Level	24	12	16

It should be noted that cholrine rises with increased applications of potash: at the lowest potassic level the amount of chlorine applied is 4 lbs. 3 ozs. per acre, whilst at the second and third levels the amounts are 12 lbs. 11 ozs. and 21 lbs. 4 ozs. per acre respectively.

Field Observations.

1. **Notes on Plant Growth.**—The greatest differences which could be seen between the treatments concerned the nitroge-

nous dressings, in which the three levels could easily be picked out on account of the increasing darkness of the plants and the fuller growth with increasing nitrogen. Plots receiving 24 lbs. phosphorous per acre were noticeably lighter and smaller than those receiving the heavier dressings, whilst no differences could be detected between the three potash dressings.

2. **Flower Counts.**—The number of plants in flower were counted at weekly intervals during the flowering period. The rate of flowering was hastened by the application of phosphorus and nitrogen from the first to the second level. Further additions of these elements showed only a slight increase. Potassium exerted none, or at the most, only a small effect upon the rate of flowering.

3. **Leaf Size and Shape.**—Four leaves per plant were chosen for measurement, the bottom and top reapable leaves and two others in an intermediate position.

Nitrogen was found to have exerted the greatest effect upon the length and breadth of all the four leaves measured, since they became longer and broader with increasing amounts of this element. Phosphorus and potash behaved in a similar manner, except that the differences were not so great as in the case of nitrogen.

Within any single plant there were found little differences in leaf length in those treatments receiving the smallest amounts of nitrogen. That is, the leaves on a plant fertilised at the rate of 12 lbs. nitrogen per acre were roughly equal, although, of course, they were broader at the bottom and became narrower towards the top of the stem. With increasing amounts of nitrogen longer and broader leaves were formed in the middle and top portions of the plant; the general effect was to give the crop a much better "grown out" appearance. The same was true for potash, but in this case the effect was much smaller. With phosphorus little differences could be detected.

It was further noticed that with increasing manurial quantities breadth increased proportionately rather more rapidly than length, so that the leaf became relatively somewhat broader. This relative increase in breadth occurred

equally in all the leaves measured and was not confined to the bottom leaves only. In fact, the bottom leaves did not "flare" in the sense of becoming much broader without increasing in length at the same time.

These changes in the proportion of the length to breadth were found to be of a very small order, being only 3% approximately. These results are, of course, based on one year's work only and require confirmation.

Yield.

TABLE 1.—*Yield of Cured Leaf at varying Levels of Phosphorus, Nitrogen and Potash.*

	1st Level.	2nd Level.	3rd Level.
Phosphorus: lbs. per acre	24	52	80
Yield: lb. per acre	906	1000	1002
,, % of mean	93.5	103.1	103.4
Nitrogen: lbs. per acre...	12	24	36
Yield: lb. per acre	850	1006	1052
,, % of mean	87.7	103.8	108.5
Potash: lbs. per acre.	16	48	80
Yield: lbs. per acre... ...	959	955	969
,, % of mean	96.9	98.6	102.5

Mean =969 lbs. per acre.

S.E. =21.07 lbs. per acre or 2.18% of the mean.

Significant Differences:—

77 lbs. per acre or 7.9% at P = .01.
58 lbs. per acre or 6.0% at P = .05.

The first addition of phosphorus over the lowest level increased the yield by 100 lbs. per acre. A further addition had no effect. With nitrogen a real increase of 150 lb. per acre of cured leaf occurred with the first increase; a smaller and a more doubtful extra yield of about 50 lbs. per acre was obtained by a further nitrogenous addition. Increase in potash was without effect upon yield; the small rise at the highest level might probably have been due purely to chance.

TABLE 2.—*Yields of Cured Leaf at varying Levels of Phosphorus and Nitrogen acting together.*

			1st Level.	2nd Level.	3rd Level.
			Nitrogen: lbs. per acre.		
	Phosphorus: lb. per acre		12	24	36
1st Level.	24	Yield: lb. acre	852	906	961
		% mean	87.9	93.5	99.2
2nd Level.	52	lb. acre	862	1036	1100
		% mean	88.9	106.9	113.5
3rd Level.	80	lb. acre	837	1074	1094
		% mean	86.4	110.8	112.5

S.E.=37 lbs. per acre or 3.8%.

Significant Differences:—

132 lbs. per acre or 13.7% at P=.01.

101 lbs. per acre or 10.4% at P=.05.

Increases in yield with additions of phophorus were essentially similar whatever the amount of potash present and *vice versa*; whilst additions of nitrogen produced the same yield increments irrespective of the potassic level employed. Any differential response may well be due to chance.

For nitrogen and phosphorus any increase in yield due to the addition of one ingredient depended on the amount of the other present also. This may be seen from an inspection of Table 2. Thus at the lowest level of phosphorus increasing nitrogen caused only a small increase in yield. The addition of nitrogen at the second phosphatic level produced a very much larger increase in yield than did the equivalent quantity added without a corresponding increase in phosphorus as well. Any further nitrogenous addition only produced the same increase in yield as it did at the lowest level of phosphorus. A still heavier increase in yield is returned for the same quantity of nitrogen if now a further addition of phosphorus be made at the same time. As before, further additions of nitrogen led to much smaller yield increases.

Conclusions.—1. Increase of phosphorus from 24 lbs. to 52 lbs. per acre led to a real increase in yield of about 100 lbs. cured leaf per acre. A further addition to 80 lbs. phosphorus per acre gave no greater yield.

2. Increase of nitrogen from 12 lbs. to 24 lbs. per acre led to a real increase in yield of about 150 lbs. per acre. A further addition of 36 lbs. nitrogen per acre gave only a small extra yield.

3. An increase in potash from 16 lbs. per acre to 48 lbs. and from 48 lbs. to 80 lbs. per acre did not increase yield.

4. The tendency was observed for one manurial ingredient to act differently in the presence of a second. This tendency or interaction was greatest with phosphorus and nitrogen where an increase in one was greatly modified if the other were varying at the same time also. Probably the most economical use of both manures was obtained when both were together at the second level of each.

Price per Pound.—Of the three manurial ingredients tested only nitrogen had any influence upon price per pound. Phosphorus and potash were without effect. The prices realised (for variations in nitrogen only) are shown in the subjoined table.

TABLE 3.—*Price per pound of Cured Leaf with varying amounts of Nitrogen.*

	1st Level.	2nd Level.	3rd Level.
Nitrogen: lbs. per acre.	12	24	36
Price: Pence	7.89	7.73	7.54
%	102.2	100.1	97.7

Mean=7.72d. S.E.=.04d. or 0.52%.

Significant Differences:—

0.11d. or 1.43% at P=.05.
0.15d. or 1.89% at P=.01.

Increase in nitrogen has resulted in decrease in price per pound, the drop in price from the first to the second level, and from the second to the highest level being significant in both cases at the one per cent. point.

It should be noticed, however, that these decreases, although established statistically are nevertheless of a very small order, 0.16d. and 0.19d. respectively.

Changes in prices caused by variation in one ingredient over all levels of a second are regular and uniform.

Conclusions.—1. Phosphorus and potash without effect upon price per pound.

2. Increase in nitrogen led to decreases in price.
3. Interactions small and negligible.

Value per Acre.

TABLE 4.—*Values obtained with varying Manurial Quantities.*

	1st Level.	2nd Level.	3rd Level.
Phosphorus: lbs. per acre	24	52	80
Value £ per acre ... ... %	£29/5/- 93.9	£32/1/- 103.0	£32/3/- 103.2
Nitrogen: lbs. per acre...	12	24	36
Value £ per acre ... ... %	£28/-/- 89.9	£32/8/- 104.0	£33/1/- 106.1
Potash: lbs. per acre ...	16	48	80
Value £ per acre ... ... %	£30/14/- 98.6	£30/17/- 99.1	£31/18/- 102.4

Mean=£31/3/-. S.E.=14/7.

Significant Differences:—

£2/13/- or 8.6% at P=.01.
£2/1/- or 6.5% at P=.05.

Increases in value were obtained with all three ingredients. In the case of phosphorus and nitrogen the increase given by a rise from the first to the second manurial level reached the 1% level of significance, whilst further additions led only to very slight non-significant extra values. Although the addition of further quantities of nitrogen over the first level led to a decrease in the price per pound, yet the final

gross returns still show an increase due to the much greater effect exerted by nitrogen upon yield. The differences between the various levels are not now, of course, so great as was the case with the yield figures.

Increases in potash show slight increases in value with each addition, but they do not reach significance.

Crop Values.

TABLE 5.—*Crop Values at varying levels of Phosphorus and Nitrogen acting together.*

			1st Level.	2nd Level.	3rd Level.
			Nitrogen: lbs. per acre.		
	Phosphorus: lbs. per acre		12	24	36
1st Level.	24	Value £ per acre	£28/4/-	£29/5/-	£30/5/-
		%	90.6	93.9	97.1
2nd Level.	52	£ per acre	£27/19/-	£33/15/-	£34/9/-
		%	89.8	108.4	110.7
3rd Level.	80	£ per acre	£27/15/-	£34/3/-	£34/9/-
		%	89.2	109.7	110.6

S.E.=£1/5/- or 4.06%.

Significant Differences:—

£4/12/- or 14.8% at P=.01.
£3/10/- or 11.3% at P=.05.

Increases in crop values caused by additions of phosphorus to the fertiliser were the same whatever the amount of potash given, and additions of nitrogen gave the same value increases irrespective of the potash level employed. When phosphorus and nitrogen are considered together crop returns depend, as they did in the case of yield, on the actual amount of both ingredients in the fertiliser; an addition of one ingredient will produce a response depending on the quantity of the other present also. This is clearly indicated in the table.

Cost of Fertiliser.—The increases in value yielded by the various treatments have been offset to some extent by the extra cost of fertiliser. In Table 6 is given the net profit and loss per acre.

TABLE 6.—*Profit or Loss shown by Manurial Treatments.*

	P2-P1	P3-P2	N2-N1	N3-N2	K2-K1	K3-K2
Extra returns per acre	£2/17/-	2/-	£4/8/-	15/-	3/-	£1/-/-
Extra cost of fertiliser	7/-	7/-	6/-	6/-	8/-	8/-
Net gain	£2/10/-	Loss 5/-	£4/2/-	7/-	Loss 5/-	£-/12/-

The table is self explanatory and emphasises the much smaller net increases yielded after the optimal manurial quantities have been applied.

Conclusions.—1. Additions of phosphorus and nitrogen led to increased financial returns. Further additions exerted only very small effects. In the case of phosphorus the second addition was accompanied by financial loss.

2. Additions of potash exerted at the most very small effects.

3. Additions of certain fertiliser ingredients were not able to produce their greatest response unless some other ingredient was raised at the same time. This was particularly noticeable in the case of nitrogen and phosphorus.

Maturity Data.—Increases in phosphorus led to increases both in relative maturity and in the actual weight of leaf harvested. Nitrogen in increasing quantities on the other hand exerted a delaying effect upon the ripening of the leaves. Since, however, increases in this element led to large increases in yield the net effect was that the second level of nitrogen showed the greatest weight of leaf harvested at any given date.

Potash exerted little effect on leaf ripening. The first picking was unaffected by increase in this element and the tendency in subsequent pickings was for high potash to depress maturity. Owing to the slight stimulating effect on yield the net result was that the actual weight of leaf remained the same.

Stand and Number of Leaves Harvested per Plant.—Since the yield amongst the treatments has been shown to vary it is of interest to enquire in how far these differences may be due to a differing number of leaves actually reaped.

The stand did not vary very considerably from treatment to treatment, but from the lowest to the highest level of nitrogen there was a small increase in the number of plants per plot. Potash was without effect upon plant number.

The number of leaves reaped per plant was the same irrespective of the amount of phosphorus or potash applied in the fertiliser. With nitrogen there appeared to be more reapable leaves with increasing quantities of this element. But the increased number of leaves picked was found to be due to the larger number of plants in these plots containing more nitrogen. When a correction had been made for stand nitrogen fell into line with phosphorus and potash in that a plant produced the same number of leaves whether it was given a smaller or a larger amount of this element.

These figures are of interest in showing that for an equal number of plants the number of leaves reaped has been quite independent of the quantities of fertiliser supplied. Of practical importance is the fact that yield may be raised without increasing the number of leaves reaped from one plant but by increase in the size and weight of the existing leaves only.

Discussion.—Of the manurial ingredients studied those which produced the greatest response in the tobacco plant were phosphorus and nitrogen.

The first addition of either of these two elements exerted with the exception of leaf number only, a considerable influence upon all the factors studied. Further additions over the second level led in some cases to much smaller further effects, whilst in others there was no response at all. There is, of course, nothing new in this concept, since it is in entire agreement with well established physiological laws. There is an optimum level for any growth promoting substance. Increases over this level lead to decreased returns and a point is finally reached at which a factor may become definitely harmful.

From the experiment just described it is impossible to say immediately which are the optima for the ingredients and for the conditions under test, since only three definite levels of each have been tried out, and those levels were widely separated. For phosphorus, at any rate, the optimum for the conditions experienced would seem to be somewhere between the first and second levels, that is, between 24 lbs. and 52 lbs. per acre; for it is seen that no further response was obtained from increases over the latter rate. No purpose would be served by increasing the quantity of this fertiliser; in fact, a decline in yield might be the result of over-fertilisation.

With nitrogen the most economical level for the conditions under test might be found to be slightly more than 24 lbs. per acre. Since increased nitrogen has exerted a depressing effect upon price the peak dressing for yield and financial returns would not coincide. There would be a separate optimum nitrogenous dressing for each, and the most economical application would lie between the two.

Potash has shown very little effect at any of the levels tried. This is not to say that it has had absolutely no effect upon the crop, since there are factors connected with burning and aroma upon which no tests of any sort have been made. The necessity for such work is clearly indicated before recommendations may be put forward concerning the value of this or of any other element. Obviously potash is as necessary in the life of the tobacco plant as are the other two manurial ingredients, but as far as the building up of tissues is concerned it would seem that there had been sufficient potash in the soil to satisfy the requirements of the crop.

Obviously then fertiliser practices involving greater financial returns to the individual farmer should not be made if they are likely to be accompanied by a reduction in smoking quality. Such a policy would, from the Colony's point of view, be a retrogressive one. Investigations into smoking quality are absolutely necessary and must go hand in hand with fertiliser trials.

One further point falls to be considered, the interaction between manurial ingredients. Although among the inter-

actions none reached significance, a tendency was seen for the response to one ingredient to be modified in the presence of varying amounts of the second.

In other words, the differences in yield caused by addition of one ingredient were not the same at all levels of a second, but varied with the actual amount of the second ingredient present.

These differential responses or interactions are of very great value in fertiliser work and yield information, which cannot be obtained from a study involving the variation of one ingredient only.

Finally, it is evident that the optimum fertiliser levels found will be true only for the soil and for the climatic conditions of the experiment. The necessity for carrying on a fertiliser trial for a number of seasons to enable the most suitable combination to be obtained giving the best results over a number of years, is obvious and generally realised. The question of soil is possibly of not such wide knowledge, but it must be evident that before general recommendations may be made any trial involving fertilisers must also be carried out over as wide a range of tobacco soil types as possible.

The Effect of the Addition of certain Minor Elements upon Yield and Quality.

Object.—To test whether insufficiency of certain minor elements was proving a controlling factor in plant growth and whether any improvement could be effected by additions of such elements.

Layout.—Four randomised blocks of nine plots each with four replications. Second year land. Plots 1/40th acre with edge rows discarded at harvest.

Field Observations.—Observations on the growing plant were rendered difficult owing to great variation. Differences between blocks were not constant. Generally, however, the check plot possessed smaller, lighter plants with less well developed leaves. Flower counts showed no differences between plots.

General Conclusions.—The addition of salts of certain minor elements to a commercial fertiliser has, in some cases, given greater financial returns than when these salts were omitted. The chief effect of the salts was to increase yield and hence crop values. The price of the tobacco remained unaffected by the additions.

Some of the differences between plots receiving the minor elements and those lacking them may be ascribed to differences in plant number, but there still remains an effect which could only have been due to treatment. Confirmation of these results is necessary before any recommendations may be made.

The Effect of Type and the amount of Nitrogen and Lime upon Yield and Quality in Tobacco.

Object.—To test the effect on the tobacco crop of applying nitrogen in four forms and three levels both with and without lime. The forms tried were: (*a*) bloodmeal, (*b*) urea, (*c*) cyanamide and (*d*) fishmeal. These forms supplied one-third of the total nitrogen, the remainder being given as sulphate of ammonia.

Three nitrogenous levels were applied: (*a*) no nitrogen, (*b*) 14 lbs. nitrogen per acre, and (*c*) 28 lbs. nitrogen per acre. In addition half the experiment received a dressing of lime at 500 lb. per acre.

This experiment is a repetition of that laid down in 1936-37 and reference should be made to the report of the Tobacco Research Board in the *Agricultural Journal* for May, 1937, where full details are available.

Field Layout.—Four randomised blocks partially confounded with four replications. Edge rows were planted and discarded at harvest.

Field Observations.—From notes taken during the growing period it was seen that the series containing twenty-eight pounds of nitrogen was on the whole darker in colour and was more advanced than the fourteen pound series; whilst the treatment which had received no nitrogen contained dwarfed plants very light in colour which did not start growth for some considerable time after planting out.

No differences were detected between the limed and unlimed plots.

Yield.—Nitrogen applied at 14 lbs. per acre increased the yield from 270 lbs. to 410 lbs. per acre, or nearly 50% over those plots receiving none. A further equivalent addition produced a much smaller increase of about 35 lbs. per acre. Although the yields for 1935-36 were very much greater than for the present season, yet it is interesting to note that the differences between the nitrogenous levels have remained relatively constant.

With regard to the types of nitrogen little differences in yield were obtained at a dressing of 14 lbs. per acre. Fishmeal and urea produced the greatest weight of leaf with 390 lbs. per acre each, whilst the yield given by bloodmeal was 380 lbs. per acre.

At a dressing of 28 lbs. per acre of nitrogen, somewhat larger differences appeared. Fishmeal again yielded the greatest weight leaf with 510 lbs. per acre, urea gave 470 lbs. and bloodmeal 410 lbs. per acre. These differences may, however, been due to chance, but they are interesting since they agree with those obtained in 1935-36, in which an increase of nitrogen from 14 to 28 lbs. per acre gave no further yield increase with bloodmeal as against 18% for urea. The figures this year are 8% increase for bloodmeal and 20% increase for urea.

Lime has been absolutely without effect upon yield, either at the single or double nitrogenous dressing.

Conclusions.—1. A real increase of yield with addition of nitrogen of 14 lbs. per acre to a treatment receiving none. A further addition of 14 lbs. produced only a small further increase.

2. No differences were apparent between the various types of nitrogen at 14 lbs. per acre. At 28 lbs. per acre very little further yield was obtained with bloodmeal.

3. Lime was without effect upon yield.

4. These results are in agreement with those of 1935-36.

Price.—None of the treatments exerted any effect upon price. This is contrary to the results obtained last season, in which the first addition of nitrogen gave an increase in price and a further dressing a decrease.

No nitrogen and the single dressing have given the same price, 7.96d. per lb.; there was a drop with a further addition of nitrogen of ¼d. a lb., which does not reach the level of significance. Lime has exerted no effect and the differences between the various levels of nitrogen with and without lime might quite well have been due to chance.

With increasing nitrogen there was a drop in price with all the forms tested. This drop was least in cyanamide and urea, larger in fishmeal, and greatest of all in bloodmeal.

Conclusions.—1. Type of nitrogen has exerted no effect upon price with and without lime. All qualities showed a drop in price with increasing quantities, but the differences between them were not significant.

2. Lime has no effect upon price.

Value.—Only quantity of nitrogen has exerted any influence upon crop values. Neither the various forms tried nor the addition of lime had any effect. The various interactions are of no importance.

Again the relative increases of last year hold in spite of the differences in value. The first addition of 14 lbs. per acre of nitrogen increased the value of the produce from £9 1s. 0d. per acre to £13 7s. 0d. per acre, or an increase of nearly 50%. A second equivalent addition, bringing the total nitrogen to 28 lbs. per acre, resulted in a gain of £1 per acre by raising the crop returns to £14 7s. 0d. per acre. Considering the extra cost of the fertiliser is about 10s., the increase is worth roughly 10s. per acre. This increase, too, is rather doubtful and could easily have arisen by chance.

Lime exerted no effect either as a general dressing or of the separate nitrogenous levels are considered individually.

At a dressing of 14 lbs. nitrogen per acre all the types of nitrogen produced a nearly equal return. But at 28 lbs. per acre the increase with bloodmeal was only 7%, or from

£12 10s. 0d. to £13 8s. 0d. per acre. Urea showed an increase of 20% from £12 14s. 0d. to £15 5s. 0d., whilst the crop values obtained by using fishmeal rose from £13 an acre at a dressing of 14 lbs. nitrogen to £16 10s. 0d., or an increase of 27% at the higher level.

These results follow quite naturally from the yield figures, since price was but little affected by changes in the form of nitrogen used.

Lime exerted no effect upon crop values, either as a general dressing or if the separate nitrogenous levels are considered individually.

Stand.—A count of missing plants was made at harvest. In the plots without nitrogen the number of plants present was 44% of the possible, whilst in the first and second nitrogenous levels it was 60% and 61% respectively. No correction has been made, since the lesser number of plants in the no nitrogen plots may well be part of the treatment effect.

This extremely poor stand is responsible, of course, for the low yields of the experiment.

A Comparison of American and Rhodesian Fertiliser and Spacing.

Object.—To compare the fertiliser and spacing commonly adopted in Rhodesia with those stated to be employed in America.

Manuring and Spacing Rates.—Accordingly a 3 ft. x 3 ft. layout cup fertilised at 250 lbs. per acre with No. 4 bloodmeal proprietary fertiliser was tested against a 4 ft. x 2 ft. spacing having the fertiliser bulked up with sand and broadcast at 1,000 lbs. per acre. The Rhodesian land was hilled up and ridged at priming, whilst the American layout was ridged immediately after fertilising. A wide range of American fertiliser recommendations was encountered and a compromise effected from amongst them.

Field Observations.—Both series did not receive the fertiliser until some three weeks after planting out and suffered acutely from lack of foodstuff.

The tobacco receiving the Rhodesian fertiliser developed into a field of light colory leaf rather poorly grown out. This tendency increased with time and the impression gained at harvest confirmed and strengthened this view.

The American dressing, on the other hand, produced larger and darker plants with bigger leaves, which showed few signs of ripening at the first picking of the Rhodesian blocks.

Notes on the Graded Leaves.—Notes taken at grading showed the American leaf to be definitely larger than the Rhodesian. This latter treatment produced a light bodied crop of bright leaf, well described by the term "chaffy" and singularly lacking in oil; whereas plots receiving the American fertiliser and spacing gave larger leaves, possibly somewhat darker in colour, but with a "fuller" and more oily feel when smoothed out between the fingers. They were much more pliable.

General Conclusions.—Price, yield and total value have been increased by the adoption of an American system of spacing and fertilising instead of the standard Rhodesian practice. This increase has been found to have been due to three main causes:—

1. Increased number of plants from closer spacing.
2. Increased yield and value per plant.
3. Increased price per pound of the tobacco.

(To be continued.)

Some Practical Experience with Contour Ridging in Matabeleland.

By D. E. Williams, of Hurst Farm, Inyati.

The cogent reason for the practice of water conservation may be summed up in the words "rather the water in your soil than in the ocean." The following is a description of a method by which most of the flood water on the average Matabeleland farm may be held up and put to a useful purpose in improving pasturage and hay lands, at the same time bringing up the level of the underground water supply.

The method adopted is the use of contour ridges in conjunction with small scooped-out dams. It can be used on any grass lands and is particularly suitable on the "black-turf veld" grass. This grass, of the highest stock-feed value as hay, in seasons of erratic rainfall, is often so small in growth as to be hardly worth mowing, but if it is flooded whenever possible, it will remain green for a longer period and will give extra yields well worth the small outlay involved.

To carry out the scheme without much extra outlay the greater part of the work can be arranged to be done when other farming operations are slack and may be spread over years.

A Government Irrigation Engineer will lay out the lines at no cost to the farmer, and a Government grant is given towards the cost of approved schemes.

The Furrow.—To begin, a furrow is constructed round the headwaters of any spruit or a small weir built across it at a convenient place. From the point selected the water is then led away along the contour of the country until the high part of the rising ground is met, where the water is then spilled out. Water can, of course, be let out at any point along the furrow if required.

Below the point where the water spills out contour ridges are run across at convenient places to catch the overflow from the furrow, and these ridges are carried across the veld and discharge their water either into small dams or over the land, thereby flooding the grass.

Anywhere along the diversion furrow where the ground on the upper side can be ploughed and where the formation below the ground surface is suitable, small dams may be made cheaply with plough and dam scraper.

If there is any particular place where it is desired to make a dam or spill out the water for flooding, instead of starting the furrow from the spruit, the line of the furrow can be surveyed back from the dam or spill-out site on an up-grade until the line arrives back at a point in the spruit, and at this point the furrow is commenced or the small weir built on the spruit.

Once the lines of the furrows and ridges are pegged single furrows should be ploughed along them and the lines will then remain for years.

Ploughing, and After.—After cutting out and stumping has been done, the furrow, contour ridges or places for dam should be ploughed, to the required widths, as deeply as a single furrow plough will allow, while the ground is still moist. Once this has been done the remainder of the work can be continued at any time during the dry season.

After ploughing, the furrows are cleaned out and the earth dumped along the lower side with a dam scraper. The contour ridges may have a shallow ditch, the width of a dam scraper, along the upper side, as all the soil possible is required for filling weak places, hollows, etc.

For second and later ploughings a disc plough or ditcher may replace the single furrow plough if soil conditions are suitable.

Even if the work is only half finished and heavy rains fall, no great damage is done, as the veld does not scour in the same way as ploughed lands, and by doing the headlands first, one has some results for each season's work.

A point to note is that the dams, being on comparatively high ground, are in positions where seepage from them will do most good, as against dams made at the bottom of low-lying vleis or spruits.

A few miles of this sort of thing will absorb almost any storm we experience.

From my experience of this system over one and a half rainy seasons, I am convinced it is well worth while as a business proposition.

(Reprinted from the *Bulawayo Chronicle* with the permission of the Editor.)

A Plan for the Winter.

By Dr. J. Fisher, Cedara School of Agriculture.

Every year certain parts of South Africa seem to produce a surplus of grass, while others suffer from drought. In the former case valuable stock-feed goes to waste; in the latter the farmer is at a loss to know what to do. However, in most areas of this country a dry winter of four months or longer is always experienced. This is a normal state, and, as such, it demands that the farmer take full cognizance of it in providing for his live stock for the winter. Many farmers do not know how much provision should be made per animal for a period of four months.

According to feeding standards, and taking the lowest quantity required by farm live stock, the following are required:—

Per 1,000 *lbs. Live Weight per Day.*

Oxen at rest...	18 to 20 lb. dry matter.
Fattening cattle	30 lb. dry matter.
Milch cows	25 to 35 lb. dry matter.
Sheep	20 to 25 lb. dry matter.
Horses	20 to 25 lb. dry matter.

This is the bulk that is required; 20 lb. per 1,000 lb. live weight per day for four months, or 120 days, work out at 2,400 lb., i.e., 1 1-5 tons. Now, a 1,000 lb. ox is a small ox. Many oxen are 1,200 to 1,300 or 1,400 lb. live weight, and a 1,200 lb. ox will require one-fifth more than a 1,000 lb. ox. Thus, instead of 1 1-5 tons, just over 1 2-5 tons will be required. Again, for animals requiring 30 lb. dry matter for 1,000 lb. live weight, it will be 1.2+.6 tons, *i.e.*, 1.8 tons, and if the animal is 1,200 lb. it will require one-fifth of 1.8 tons more, making its total requirements about 2 1-6 tons.

From these figures the farmer can calculate the quantity of roughage he will require for the winter.

The next point is how many acres of crops, etc., he will require to produce this quantity of feed. For determining this he will have to rely on his own knowledge as to the average yield of his crops.

Assume that the oxen will be carried through on good veld hay, or teff hay, or stooked maize stalks. In the case of veld which yields 1 2-5 tons of hay per acre, which is a good yield, 1 acre will be required to supply the hay for a 1,200 lb. ox for four months. Thus, with 1 acre per ox, the farmer knows how much veld hay of that quality he must make. If he can secure double the yield of teff that he does of veld hay, then half the acreage of teff will suffice. In the case of stooked maize stalks estimated at 20 to 30 cwts., 1 acre will be required per ox.

This constitutes just the bulk without any reference to quality. Though the quantity will suffice the quality will be too low for oxen doing steady work throughout the winter.

For dairy cows, fattening stock, etc., roughage of a much higher quality will be required. In practice, the requirements of such animals cannot be met from roughage alone and they must also be given concentrates. As the concentrates are increased in accordance with the production, so the roughage is reduced. It would be of great assistance to farmers to become acquainted with the principles of correct feeding and balancing rations. The necessary information can be obtained in text books on live stock feeding, or otherwise farmers may attend short courses at the Schools of Agriculture.

For a dairy cow the same quantity of roughage should be provided as for an ox; a heavy horse also requires similar quantities.

Assuming that 10 merinos weigh the same as an ox then the same provision should be made for every 10 merino ewes as for an ox.

It is almost impossible to estimate the acreage of green feed required, since yields are so variable owing to differences

in management and climatic conditions. Ewes may be kept almost entirely on green oats, Italian rye grass, rape, or other root crops.

It would not be possible to produce the quantity of root crops required for all the types of farm live stock, hence it will be necessary to compromise.

The figures given should have some value as a guide to the farmer in building up enough winter feed for his farm live stock, and officers of the Schools of Agriculture will also compute and balance rations for the different classes of farm live stock if requested to do so.—(Union of South Africa Department of Agriculture Press Service.)

Some Trees Shrubs, Shrubby-Herbaceous Plants, Climbers and Water Plants

SUITABLE FOR THE COLONY.

By J. W. BARNES, Manager, Government Forest Nursery, Salisbury.

(Photographs by the Author.)

(*Continued.*)

Khaya nyasica (Banket Mahogany).—The largest indigenous tree in the Colony, and producing a valuable timber; only to be grown as large timber where there is plenty of moisture; has reached a height of 30 feet in 15 years in Salisbury. Seeds.

Kniphofia rooperi.—Commonly called Red Hot Poker; an indigenous aquatic plant found growing in vleis or wet ground; can be grown successfully near a leaky tap, or water garden; division of roots.

Lagerstrœmia indica (Pride of India).—Also called the Crepe Flower; there are white, pink and mauve varieties; leaves turn red before falling. They are rather large shrubs, reaching a height of 15 feet; the best heads of flowers are obtained by annual pruning; very hardy. Cuttings.

Lagerstrœmia regina.—A small shrubby tree with much larger leaves and flowers than *L. indica;* of a mauve colour; hardy. The leaves have fine Autumn effects before falling. Cuttings.

Lagunaria patersonii.—An evergreen tree 25-35 feet in height, producing pretty pink flowers; not very successful in Mashonaland, but does well in Matabeleland, where it is used as a street tree in Bulawayo. It is rather dangerous for children, as the numerous seed capsules contain countless small irritating hairs. Seeds.

Lantana salviæfolia.—Grows to 18 inches at the most, and is useful for edgings; has pretty pink flowers; does not seed; useful on rockwork; hardy. Cuttings.

Lantana sp. (Cherry Pie).—A straggling shrub; the common colour of the flower is orange and red; grows like a weed; has been used as hedges, but is not now recommended, as the seeds are carried by birds and the shrub germinates everywhere, and is liable to become a serious pest. A white variety grown does not seed freely, so is safe to plant, and is worth growing. Cuttings.

Lasiandra macrantha or *Pleroma macranthum.*—A small shrub 6 feet high; evergreen; has beautiful large purple flowers, the bush is easily damaged by high winds, and is inclined to die out after a few years. Cuttings.

Latania borbonica or *Livistona chinensis* (Bourbon Palm).—A handsome fan palm, suitable for the verandah or sheltered position outdoors. Seeds.

Leucæna glauca.—A small bush growing to 6 feet high and bearing small whitish flowers; this shrub was introduced for trial as a stock feed, for which it may be of some value. Seeds.

Ligustrum lucidum (Chinese Privet).—A very good species for hedges, especially in heavy vlei soils, or where it is rather wet; to make a dense hedge it must be cut back regularly from near the ground up, or it will be too thin later on. Seeds.

Lonicera periclymenum (Common Honeysuckle).—A very hardy and rapid climber, flowering freely; needs regular attention to keep it neat. Cuttings.

Lonicera sempervirens (Trumpet Honeysuckle).—A rapid climber; hardy; evergreen; scarlet flowers in profusion; flowers long tubular trumpet shaped. Cuttings.

Also yellow variety similar to above. Cuttings.

Maclura aurantiaca (Osage Orange).—A very thorny and strong grower, of a semi-climbing habit; is useful as a cattle proof hedge. Seeds or cuttings.

Magnolia grandiflora.—A small tree up to 20 feet in height; slow grower; produces single white flowers in summer; flowers up to one foot across are common. Seeds, but difficult to germinate.

Mandevilla sauveolens.—A strong and hardy climber, with clusters of large white scented flowers in summer. Seeds.

Mangifera indica (The Mango Tree).—The mango is a hardy tree in Mashonaland, but is inclined to be damaged by frosts; fruits readily, and some fairly good fruits are always available during summer. Seeds.

Maurandia antirrhiniflora.—A hardy evergreen climber; strong grower; has small ivy-like leaves, and is usually covered with flowers of different shades of blue, pink or white; it is a very good plant for use on tennis court wiring, but the top of the wire fence should be strengthened with piping to hold the weight. Seeds.

Melia azadarach (Syringa).—A rather large deciduous tree, somewhat like Cedrela; was used extensively at one time for street and garden trees; pretty sweetly scented flowers of a lilac colour, in large panicles; its timber is excellent. Seeds.

Michelia champaca.—A small evergreen tree, producing sweetly scented golden yellow flowers; inclined to die out in a few years, and probably needs a wetter district than Salisbury. Seeds.

Monstera deliciosa.—A large leaved evergreen climbing plant bearing an edible fruit; its leaves are the main attraction, there are about 2 feet long, and over 1 foot wide, and are perforated in an unusual way; is a good plant in a warm situation, and planted against a tree for it to climb; it must have some shade. Offsets.

Morus sp. (Mulberry).—Several species are grown and thrive like weeds. A large fruited variety introduced many years ago by Mr. Justice McIlwaine grows to perfection and is well forth growing for its large fruits. Cuttings.

Muehlenbechia platyclada.—Is a small shrubby herbaceous plant up to 6 feet high, with curious flat branches; small insignificant flowers and red berries; has nothing much to recommend it.

Murraya exotica.—An evergreen shrub of great excellence for hedges, making probably the best hedge in the Colony. It has dark green pinnate leaves, and in early Spring is covered with sweetly scented white flowers; there are only a few hedges to be seen at present, as it is most difficult to obtain good seed, and is very difficult to strike from cuttings. It also makes a fine shrub. Seeds.

Musa ensete.—A banana-like plant, indigenous to the Colony, growing to a height of 12 feet, along the Eastern Border, and always in sheltered places which are inclined to be wet. The plant lives about 12 years, then flowers and dies; the fruits are like bananas, but are filled with hard seeds about three-eighths of an inch in diameter, and from these plants are easily raised. Seeds.

Myrtus communis (Myrtle).—Evergreen shrub, flowering freely in Spring; white. Seeds or cuttings.

Nephrolepis sp. (Sword Ferns).—Beautiful tender ferns, suitable for the verandah and having remarkable variations in the fronds; some are very useful for hanging baskets. Divisions.

Nerium oleander (Oleander).—A hardy, strong shrub, growing to 15 feet, and providing a blaze of colour during most of the year; flowers salmon pink, also a white and a dark red variety. The shrub is considered very poisonous. Cuttings.

Nymphæa spp. (Water Lily).—A genus of water plants with beautiful flowers and suitable only in the water garden. The common Rhodesian species has bluish-white flowers, but there are a number of other colours to be had by importation; easily transplanted from rivers to the private pond. Roots.

Osmunda regalis (Royal Fern).—A hardy fern requiring shade and damp conditions; is to be found in cart loads along rivers in the Enterprise District. Roots.

Parkinsonia aculeata (Jerusalem Thorn).—A small thorny tree with light foliage growing to a height of 15-20 feet; flowers yellow, it is a pretty sight when in flower; also makes a good specimen. Seeds.

Passiflora cœrulea.—A useful very rapid climber; evergreen; has not fruited here.

Passiflora edulis (Granadilla).—This evergreen climber is well known as it grows like a weed nearly everywhere; produces purple fruits in abundance. Seeds or cuttings.

Passiflora quadrangularis.—This variety is similar to the above, but has larger fruits. It does not grow so readily as *P. edulis.*

Passiflora sp. (Fiji Granadilla).—A large-leaved heavy climber, with large yellow fruits; is good as a strong climber; fruits, however, do not really come to perfection here.

Passiflora sp.—A pretty pink-flowered variety; a useful evergreen climber, bearing long narrow yellow fruits.

All are raised by seeds or cuttings, and all are tender to heavy frosts; young plants must be protected during cold weather.

Pereskia aculeata (Barbados Gooseberry).—An exceedingly rank and thorny creeper, even the small fruits are covered with spines; makes a good cattle proof fence. Cuttings.

Persea gratissima (Avocado Pear).—The Avocado pear is now fairly well known, and is found to grow fairly well in most parts of Mashonaland, but not in the coldest areas; fruits well, but the tree only just grows successfully here, as shown by the fact that branches are usually found to be dying back on the trees after they are a few years old. Most of the older trees were raised by seeds, but during the past few years budded trees have been imported.

Petræa volubilis (Purple Wreath).—A straggly climber, which may be trained into a shrub; deciduous; flowers in Spring; has long racemes of deep purple-coloured flowers and is a beautiful object; small plants tender to frosts. Propagated by layers or cuttings.

Phaseolus lunatus (Seven-Year or Lima Bean).—A most luxuriant climber, which is useful as a quick growing screen; deciduous, but the vines live and throw out new growth early in Spring; is a good table bean; the dry beans soaked and boiled are an excellent vegetable. Seeds.

Philadelphus grandiflorus (Mock Orange).—Deciduous shrub up to 10 feet high; flowers in Spring usually before the leaves appear. Flowers white. Cuttings.

Several varieties are grown, all with white flowers, some being double.

Phoenix canariensis.—A species of the date palm, with large fronds; will make a good specimen; hardy. Seeds.

Phoenix dactylifera (Common Date Palm).—The date of commerce thrives slowly, making in time a handsome specimen, but will probably not fruit here; it is probable, however, that a place may be found in the Colony where it will bear fruit. Seeds.

Phoenix reclinata (False Date Palm).—A palm of the date family which is indigenous to the Colony and reaches a height of 15-20 feet; graceful and hardy. Seeds.

Phormium tenax (New Zealand Flax).—A useful ornamental plant, with sword-like leaves, up to 6 feet in height; the leaves are thrown out from the base at ground level; it is a valuable fibre plant, and there are lots of uses to which the leaves can be put, such as thatching, tying up plants, etc.; the dead and old leaves soaked in water and pulled into strips make an excellent tying material. Offsets or seeds.

Also a variegated variety, is very ornamental.

Physalis peruviana (edulis) (Cape Gooseberry).—The well known Cape Gooseberry, usually grows like a weed, and fruits profusely. Seeds.

Phytolaca dioica (Belhambra).—A rapidly growing tree up to 40 feet in height, with large soft branches and dense foliage; large surface roots are a drawback and are dangerous near buildings. The tree is used in Australia as a cattle fodder in times of drought. Seeds.

Pinus canariensis (Canary Island Pine).—Is hardy to most parts of the Colony, slower in growth than some of the other pines; it is making a good tree in Mashonaland. Seeds.

Pinus cembroides (Mexican Nut Pine).—A small beautiful tree very suitable for gardens, but thrives only on the Eastern Border. Seeds.

Pinus halepensis (Aleppo Pine).—A very hardy pine, doing fairly well in Matabeleland; is sometimes used as a hedge in Mashonaland. Seeds.

Pinus longifolia (Chir Pine).—Another good hardy tree growing well in most parts of the Colony. Seeds.

Pinus muricata (The Bishop's Pine).—Will grow into a timber tree on the Eastern Border. Seeds.

Pinus patula (Spreading-Leaved Pine).—Introduced in 1920; this handsome pine competes with *P. radiata* in rate of growth at Inyanga, on the Eastern Border, and will no doubt be of the greatest value to the Colony as a first-class timber tree. Seeds.

Pinus pinaster (Maritime or Cluster Pine).—Growing well on the Eastern Border, though much slower than *P. radiata.* Seeds.

Pinus radiata (Monterey or Remarkable Pine).—Up till recently called *Pinus insignis;* this tree has been a great success on the Eastern Border, in the Inyanga and similar districts, and is of first-class importance as a timber tree for this Colony in that district. Three or four trees planted about twenty years ago at Sir Ernest Montagu's residence at Borrowdale, Salisbury, on a contact soil, have done very well, and it seems that the tree will do best in contact or granite soils, and dies out badly in heavy diorite soils. It should be planted with caution in areas under 30 inch rainfall. Seeds.

Pinus tæda (Loblolly Pine).—Another variety successful on the Eastern Border. Seeds.

Pittosporum undulatum (Camphor Laurel).—The favourite hedge plant in and around Salisbury, where miles of healthy hedges may be seen. It is a bright green in colour, has dense foliage and stands up to the dry winters better than would be expected. It also a useful small shrubbery specimen tree. Seeds.

Plumbago capensis (Plumbago).—A good, well known shrub, but deciduous unless watered during the dry season; has beautiful, light blue flowers. Seeds or cuttings. There is also a white variety.

Plumeria occulata (Frangipani).—As below, but with creamy-white flowers. Cuttings.

Plumeria rubra (Frangipani).—Has thick succulent branches and large dark green leaves; covered in Summer with terminal cymes of fragrant yellowish-pink flowers; is not hardy to very heavy frosts, and should be protected while small. Cuttings.

Podranea brycei (Zimbabwe Creeper).—An indegenous creeper, and a rank grower in cultivation, but when in flower it makes a wonderful show with its large heads of pink flowers. Seeds or cuttings.

Poinciana gillessii (Bird of Paradise Flower).—A small deciduous shrub, about 10 feet high, having in Summer masses of red edged with gold flowers, and is a beautiful object. Seeds.

Also a fine yellow variety similar to above. Seeds.

Poinciana regia (Flamboyant).—A large flat-topped spreading ree, usually about 20-30 feet high, covered in Spring with bright scarlet flowers; is an excellent street tree, but large surface roots are rather troublesome. Trees of this variety were planted in the main street of Umtali many years ago and are famous for the wonderful show they make; unfortunately many of these trees have been removed during recent years, which has rather spoilt the effect. Seeds.

Poinsettia albida.—A variety with pale yellow bracts, not so effective as the red, but useful in large shrubberies.

A rose-pink variety is also grown, but requires partial shade, otherwise the hot sun bleaches the bracts to a yellow colour.

This variety is not a fixed type, and often reverts to single red. Cuttings.

Poinsettia pulcherrima.—A shrub with red bracts growing to 12 feet in height, spreading; deciduous; the Poinsettia grows to perfection, but sometimes in exposed situations the flower bracts are damaged by frosts; heavy pruning is beneficial, especially if large heads are required, and with a little attention can be grown with a diameter of 18 inches. Cuttings.

Poinsettia sp.—A double form is also grown, and is valuable as it is of a darker red and flowers later than the single. Cuttings.

Populus alba (White Poplar).—This tree is useful along stream banks and other moist well-drained places. It is a mistake to think that they can be planted in wet sour vleis and expected to grow successfully; if the ground cannot be ploughed and sweetened, raised mounds should be thrown up and allowed to weather, forked over in the Spring, and the suckers then planted; after being successfully established they will soon run into the wet surroundings and send out more suckers. Suckers.

Populus deltoidea var. *Missouriensis* (Carolina Poplar). —A variety introduced in 1921, and has grown well. Of the original cuttings put in at Salisbury in September, 1921, three of the rooted trees were left in and the balance moved to other quarters; the largest of the three trees left is to-day 55 feet high and 16 inches diameter, breast high; this variety seldom sends up suckers. Cuttings.

Psidium cattleyanum.—Erroneously called the Chinese guava locally; this is an evergreen small shrub up to 6 feet high and bearing small dark purple fruits which look something like strawberries; well worth cultivation for the fruits. Seeds.

Psidium pomiferum (Guava).—A small hardy evergreen tree bearing a well known fruit, pink-fleshed; there is also a white-fleshed kind. Seeds.

Pueraria thumbergiana (Kudzu Vine).—Useful rough creeper, with dense green foliage, used sometimes as a climber on trellis work; is a valuable fodder plant and grows to perfection here for this purpose. Layers, seeds or crowns.

Punica granatum (Pomegranate).—A shrub about 15 feet high; deciduous; single scarlet flowers, followed by large brightly coloured fruits. Seeds.

Also a double red flowered variety, and a double red-yellow flowered variety are grown, double kinds propagated by cuttings as they do not bear fruits and are deciduous.

Quercus ilex (Holly Oak).—Has grown slowly in Salisbury and reached a height of 13 feet in 15 years. Seeds.

Quercus pedunculata (Common Oak).—Trees of this type have reached a height of 50 feet on the Eastern Border, but it is a waste of time to plant it elsewhere. Seeds.

Rhamnus prinoides.—An indigenous small shrub, having bright shiny leaves. Has been tried as a hedge fairly successfully, though many other plants are more suited for this purpose.

Rhapis flabelliformis.—A slender palm, about 4 feet high, fan-leaved, with narrow leaflets, useful as a verandah plant; it throws up suckers from which it is propagated.

Rhus lancea (Karee Boom).—An indigenous small shrubby tree, evergreen and excellent as a rough hedge screen; quick grower. Seeds.

Rhus succedanea (Red Lac Sumach or Japanese Wax Tree).—A small shrubby tree; has so far reached a height of 10 feet; has large dark green pinnate leaves, turning to a fiery red in Autumn before falling. Seeds.

Rhus vernicifera (Chinese Lac Tree).—A small evergreen tree up to 20 feet high; has heavy bright green foliage; has thrived, but is tender to frosts the first year or two. Seeds.

Rhynchospermum jasminoides or *Trachelospermum jasminoides* (Star or Malayan Jasmine).—An evergreen dwarf creeping shrub, usually about 2 feet high, but can be trained up a trellis; is covered in Summer with clusters of small pure white flowers, highly scented. Cuttings.

Ricinus communis (Castor Oil Plant).—From the frequent occurrence of this plant in the veld in the Inyanga district I conclude that it is probably indigenous to the Colony; it is very easily grown and has been seen growing naturally to a height of 10 feet. Some of the highly coloured varieties would probably do well and be a useful addition to our shrubberies. Seeds.

Romneya coulteri (Californian Poppy).—Shrubby herbaceous plant producing large single white scented flowers; evergreen; height to 6 feet. Suckers.

Roses.—Roses, of the hybrid, hybrid teas, polyanthas, and one or two of the climbing polyanthas and Winchurian do well in the heavy soil districts, but many of the good climbing varieties will not thrive and flower freely, unless in the mist belt.

The best results with hybrid perpetuals and hybrid teas are obtained from plants raised from cuttings; plants on stock are a perfect nuisance, as they are always throwing out suckers if the roots are at all damaged while cultivating.

Rosa bracteata (Macartney Rose).—A very strong-growing climbing rose; evergreen; flowers profusely in Spring; has large single white flowers; makes an excellent cattle proof hedge, and looks well if regular attention is given to it; but if allowed to grow unchecked becomes very straggly. Cuttings.

Rosmarinus officinalis (Rosemary).—A small shrub to 5 feet with small purple flowers; it is for the aromatic leaves the shrub is grown. Cuttings.

Russelia juncea (Coral Fuschia).—A charming plant suitable for the edge of the shrubbery, growing to about 4 feet high, and throwing out new growth from the base; like asparagus. Has large spikes of small red flowers, which are excellent for cutting. Cuttings.

Salix babylonica (Weeping Willow).—A rather large tree up to 30-40 feet high, in a favourable spot; a valuable timber tree and is useful for stock feed; its long drooping branches are very effective, especially when grown along river banks. Cuttings.

Salix purpurea (Osier Willow).—One of the true Osiers, and valuable for basket making, and for which the weeping willow may also be used. This variety will grow to 10 feet in height, and will produce useful rods in two or three years. Cuttings.

Salvia involucrata.—A large herbaceous shrub to a height of 8 feet in well prepared soil carrying large heads of rosy-crimson flowers in late Summer; requires feeding and cutting back each season for the best results; tender to frost. Cuttings.

Schinus molle (Pepper Tree).—A well known evergreen tree, up to 25 feet high; well grown specimens are handsome shade trees; good specimens are to be seen in the Bulawayo area. Seeds.

Schinus terebinthifolius.—A small to large spreading evergreen tree, which is covered in Spring with small red berries. Seeds.

Schizolobium excelsum.—An extremely rapidly growing tree having large pinnate leaves and large sprays of yellow flowers in Spring; has grown to a height of 40 feet in five years in Salisbury Gardens. Seeds.

Seaforthia elegans or *Ptychosperma cunninghamiana* (Illawara Palm).—A fine large palm for verandah, or shade house, but will not stand the sun. Seeds.

Securidaca longipedunculata (Rhodesian Violet Tree).—A small deciduous indigenous shrubby tree with small leaves, bearing early in Spring masses of small reddish flowers scented like violets. Is raised from seeds, which are very difficult some years; is very slow growing, and usually dies when transplanted. Probably the only successful way to grow this is by sowing *in situ*, and when a year or two old to plant other plants near to draw it up more quickly.

Senecio macroglossus (Cape Ivy).—An evergreen climber, bright shiny leaves, and large single yellow flowers; is a rapid and showy climber. Cuttings.

Smilax sp.—Deciduous climbers, sending out new growth yearly; useful shade house plants. Two or three varieties are indigenous to the Colony. Seeds or roots.

Solanum seaforthianum.—A small flowered variety of the potato creeper, growing to 8 feet; evergreen climber; pretty blue flowers, followed by bright red berries. Seeds or cuttings.

Solanum Wendlandii (Potato Creeper).—A strong-growing rough climber, requiring plenty of room, such as a windmill tower, to show it to best advantage; damaged by frost. Cuttings.

Spathodea campanulata (African Flame Tree).—A handsome large-leaved tree to 25 feet in height with large red

flowers edged with gold; valuable as a street tree, when it should be planted at least 25 feet apart; tender to frosts while small; requires deep well drained soil; flowers in April-June; deciduous. Seeds.

Spiræa prunifolia (Cape May).—A deciduous shrub, to 6 feet high, is covered in early Spring with masses of double white flowers; is sometimes used as a hedge. Cuttings.

A single white flowered variety is similar.

Stephanotis floribunda (Madagascar Jasmine).—An evergreen climber with dark fleshy leaves and lovely white scented flowers; requires partial shade and will do on a south wall. Seeds.

Sterculia acerifolia (Australian Flame Tree).—This is a beautiful tree, with large bright green leaves, and in Spring has crimson flowers; grows to 20 feet in height; the tree is not really a success as it is inclined to die out after a few years. Seeds.

Sterculia diversifolia.—A small evergreen tree growing only to about 15 feet in 20 years at Salisbury; is a valuable tree and used in Australia as a stock food. Seeds.

Sterculia sp.—This variety is probably *S. discolor;* is a handsome flowering tree, and some fair specimens are to be seen in the streets of Salisbury, but like *S. acerifolia* is it doubtful if this species will live long. Seeds.

Strelitzia reginæ (Crane's Head).—A large herbaceous plant useful for the shrubbery; grows up to 5 feet in height and has large leaves something like the canna; produces curiously shaped flowers which strikingly resemble a Crane's head. Division of roots.

Streptosolen jamesonii.—A favourite evergreen shrub, with large heads of small orange-red flowers, flowering profusely in June-July; the flowers are damaged by frost unless in a sheltered situation. Cuttings.

Strobilanthes sp.—A small evergreen herbaceous shrub to 4 feet in height; covered with small deep blue flowers in Autumn. Cuttings.

Tecoma smithii.—A large yellow-flowered shrub up to 15 feet high; deciduous; fast grower. Seeds.

Tecoma stans (Yellow Elder).—Similar to *T. smithii*, but is not quite so large. Flowers reddish-yellow. Seeds.

Tecomaria capensis (Kaffir Honeysuckle).—A straggly creeping shrub, but a pretty plant if care is taken of it; flowers reddish-orange. Seeds or cuttings.

Thevetia neriifolia.—A bright-leaved evergreen shrub, tender to heavy frosts, golden yellow flowers. Seeds.

Thuja orientalis (Thuja).—A hardy conifer used as a hedge or small tree; height about 20 feet. It is not very satisfactory as a hedge, as odd plants have a habit of dying out for no apparent reason. Seeds.

Tithonia diversifolia.—A large herbaceous shrub, growing to a height of 10 feet, dying down to the crown each winter; large spikes of yellow flowers very similar to sunflowers. Seeds. Offsets.

Tithonia speciosa.—A small variety, to 4 feet with single red flowers. Seeds.

Trichelia emetica.—A large evergreen tree, with large dark green leaves; rather slow in growth but making a fine shade tree; tender to frosts whilst small. Seeds.

Ulex europæus (Furze, Gorse or Whin).—This well known shrub grows well at Inyanga on the Eastern Border, about 6 feet in height; evergreen; golden yellow flowers. Seeds.

Viburnum opulus (Guelder Rose).—A deciduous shrub; height up to 4 feet, large heads of white flowers; probably only successful on the Eastern Border. Cuttings.

Washingtonia robusta (Cotton Palm).—A very fine hardy palm for avenues, or specimen purposes, and is fast growing; requires deep well-drained soil, and has done best on raised mounds. Seeds.

Widringtonia whytei (Mlanje Cedar).—An indigenous coniferous tree, growing in the mountains of the Eastern Border, usually to about 25 feet in height, and about 6 inches diameter; the tree thrives best where water is seeping around

its roots; produces a fine and valuable timber, some of which is used in hut roofs at Inyanga and is as good after 25 years as the day it was cut. This conifer will coppice freely after the trees are felled. Seeds.

Wigandia macrophylla.—A large-leaved strong growing herbaceous shrub; height to 10 feet; has large terminal cymes of purple flowers. The whole plant is covered with fine spiny hairs, which if touched are very irritating; requires plenty of room to develop properly. Suckers.

Wistaria chinensis (Chinese Kidney Bean Tree).—This well known climber, although odd plants grow well, does not flower very readily. Seeds.

Zantedeschia africana (Arum Lily).—Although such a common plant in the Cape, this plant requires regular attention to grow to perfection in this Colony, and is best grown in the shade house or verandah. A pretty yellow species (*Z. melanoleuca,* Engl.) is indigenous to the Colony, and very common. Division of roots.

Zitherlyllum sp.—A large shrub, growing to about 15 feet high, and spreading leaves something like *Lagerstrœmia reginæ,* which turn a lovely brownish-yellow colour before falling in winter. Cuttings.

Rhodesia Weather Bureau.

MARCH, 1938.

Pressure.—Mean barometric pressure was uniformly about 0.5 mb. below normal.

Temperature.—Mean maximum temperatures were well above normal, except in the north, and the mean minimum temperatures were generally below normal.

Humidity.—Dew points were well below average in the south and average in the north.

Rainfall.—Rain failed very badly in the south and west and was nowhere up to normal. The average over the whole country amounted to 1.4 inches, or 3 inches below normal. The total shortfall for the season is about 4.5 inches. This has been very unevenly distributed.

A great part of the country, Gatooma and the Midlands, Matabeleland, Victoria and Melsetter have received less than three-quarters of the normal amount, while Makoni, Salisbury, Lomagundi and the north are up to or above normal.

Most of the rain fell during the first half of the month. The north and north-east portions of the country received more than other parts, and the Salisbury-Mazoe area was the most favoured.

Equatorial air covered the country on the 1st, and gave thunderstorms and rain fairly generally. Maritime air covered the south on the 2nd, extending northwards on the 3rd. Further rain occurred in the north on the 2nd and showers on the 3rd and 4th.

An easterly current with a wide sweep over the Indian Ocean then set in. The dewpoint of the air was fairly high and showers fell in parts. The current ceased on the 9th and thunder conditions prevailed until the 11th.

On the 12th a tropical cyclone developed over the Indian Ocean near the north-east coast of Madagascar, and at the same time a dry south-east current set in to the south of Madagascar, affecting Southern Rhodesia. Fair weather then prevailed in the south, but scattered showers continued in the north and east for a few days. The tropical cyclone soon lost its violent centre, but a low remained in the region of the east coast of Madagascar, and the air supply to Southern Rhodesia continued from the south-east until the 20th. Dewpoints were fairly low, and weather continued fair with irregular air movements until the 25th.

On the 26th there was again an onset of south-east winds with rapidly rising pressure. Drizzle occurred over the south end of the Eastern Border, and showers in the north on the 26th and 27th. On the 29th the current was directed towards the coast of Madagascar, and a deep low developed over the south coast of the Union on the 30th, resulting in a swing of the wind to E.N.E., which gave rise to a few showers in the north and east.

PRECIPITATION.

Station.	Inches.	Normal.	No. of days.
Beitbridge	0.20	1.58	1
Bindura	4.20	4.95	14
Bulawayo	0.09	3.31	2
Chipinga	0.50	7.91	9
Enkeldoorn	1.12	4.03	2
Fort Victoria...	1.06	3.62	4
Gwaai Siding	1.08	3.39	2
Gwanda	0.09	3.00	1
Gwelo...	0.94	3.39	2
Hartley	1.27	4.35	7
Inyanga	2.90	5.44	6
Marandellas	2.01	5.89	8
Miami	4.74	4.77	12
Mount Darwin	1.90	3.65	7
Mount Nuza	4.81	9.80	20
Mtoko	2.65	3.64	7
New Year's Gift	1.55	3.74	8
Nuanetsi	Nil	2.45	0

Station.	Inches.	Normal.	No. of days.
Plumtree	0.84	2.82	3
Que Que	1.37	3.89	2
Rusape	2.93	5.06	6
Salisbury	3.37	4.47	11
Shabani	0.50	4.05	1
Sinoia	2.71	4.11	11
Sipolilo...	4.97	4.04	10
Stapleford...	4.03	11.23	18
Umtali	1.68	5.23	9
Victoria Falls...	0.15	3.84	3
Wankie...	0.23	3.01	2
Abercorn	9.45	—	17
Broken Hill	1.80	—	6
Choma	1.53	—	4
Fort Jameson...	6.98	—	12
Fort Roseberry	4.94	—	9
Isoka	10.04	—	17
Kapiri Mposhi	3.81	—	11
Kasama...	9.04	—	18
Livingstone	0.10	—	2
Lundazi	7.91	—	13
Mazabuka...	3.68	—	7
Mkushi	3.37	—	10
Mongu	2.49	—	9
Mpika	8.87	—	18
Mporokoso	7.32	—	18
Mufilira	13.15	—	17
Mumbwa	1.22	—	7
Ndola	5.31	—	14
Petauke	5.72	—	13
Senanga	1.02	—	5
Sesheke	0.06	—	1
Shiwa Ngandu	12.12	—	18

MARCH, 1938

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	Wet Bulb.	Dew Point	Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute: Maximum	Date	Minimum	Date	Number of Days: Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
›ridge...	1,500	76.2	66.3	61	12.5	91.5	66.1	78.7	98	9th	57	31st	31	...	18	...	79.1	963.6	882.0	...	2.9	...
ura...	3,700	68.2	63.9	62	5.0	79.6	61.8	70.7	84	19th	56	19th	...	...	2	...	70.1	890.7	880.6	...	4.8	...
wayo	4,393	68.6	59.9	54	9.5	81.6	57.3	69.5	86	19th	53	18th	3	...	...	...	...	869.0	880.3	...	2.7	10.6
inga	3,685	68.7	62.8	59	7.0	77.6	59.4	68.5	84	10th	54	5th	...	...	...	...	67.8	892.0	881.4	...	5.1	...
ıldoorn	4,788	66.5	60.1	56	7.1	78.2	56.0	67.1	83	31st	51	17th	...	...	...	...	66.2	856.8	880.3	...	4.4	...
Victoria... ...	3,571	69.3	62.7	59	7.7	80.6	57.7	69.2	84	var.	51	18th	...	...	1	...	69.9	894.9	880.9	...	3.4	...
ai Siding... ...	3,278	69.2	62.4	59	8.0	90.8	56.6	73.7	98	16th	48	19th	30	...	..	...	...	903.5	880.2	...	0.7	...
nda...	3,233	72.8	62.6	56	11.8	85.5	61.2	73.3	92	10th	55	18th	15	...	4	...	73.7	905.7	881.2	...	2.6	...
ɩo	4,629	67.7	60.3	55	8.0	80.0	56.2	68.1	84	19th	48	18th	...	...	...	...	68.3	861.7	880.3	...	2.7	...
ley...	3,879	68.8	62.4	59	7.4	82.3	57.3	69.8	87	7th	49	19th	1	...	...	...	69.6	884.7	880.2	...	3.2	...
ıga...	5,503	65.4	59.6	55	6.3	74.2	53.5	63.9	79	14th	45	24th	...	1	...	...	63.6	...	...	...	4.0	...
ındellas	5,453	64.4	59.0	55	6.0	74.0	55.5	64.7	79	19th	51	30th	...	2	...	...	64.5	...	...	...	2.7	...
ıi	4,090	66.4	63.5	62	3.4	77.8	60.6	69.2	81	25th	55	31st	...	...	...	...	68.8	877.9	880.0	...	6.3	...
Darwin	3,179	69.9	65.3	63	5.7	81.0	61.8	71.4	84	19th	55	20th	..	...	6	...	70.2	906.8	...	...	8.3	...
ıt Nuza	6,668	55.6	54.5	54	1.0	62.6	51.1	56.9	69	1st	44	5th	...	31	...	...	55.1	800.9	880.0	...	8.4	...
:o	4,141	68.1	62.7	60	6.3	77.0	59.9	68.5	80	26th	56	24th	...	...	1	...	67.8	876.9	880.6	...	6.2	..
Year's Gift...	2,690	71.8	65.6	62	7.5	83.8	60.5	72.2	91	10th	53	24th	13	...	6	...	...	...	...	...	...	7.7
ıetsi	1,581	75.7	67.7	64	10.3	90.8	61.0	75.9	99	10th	52	24th	26	...	10	...	...	961.5	881.9	...	0.3	...

MARCH, 1938 (continued)

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m.: Dry Bulb.	Wet Bulb.	Dew Point	Vapour Press Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute: Maximum : Date	Minimum : Date	Number of Days: Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
umtree	4,549	70.4	60.0	53	11.7	82.5	59.6	71.0	87 : 19th	54 : 30th	3	...	...	...	69.7	864.1	880.3	...	0.7	...
ıe Que	3,999	68.8	62.0	58	7.8	83.8	57.7	70.8	88 : 19th	50 : 19th	8	...	1	...	70.2	881.1	880.3	...	2.5	...
ısape	4,648	64.4	60.4	58	4.4	75.6	56.3	65.9	81 : 10th	51 : 24th	...	2	..	...	65.6	..	...	...	5.1	...
lisbury	4,831	65.9	60.8	58	5.6	77.6	56.1	66.9	82 : 7th	50 : 28th	...	1	...	...	66.0	855.4	880.1	854.1	4.9	8.5
abani	3,131	72.8	63.5	58	11.2	84.2	60.5	72.3	90 : 10th	55 : 31st	15	...	6	...	73.2	...	...	...	3.0	...
ıoia	3,795	68.5	64.1	62	5.2	82.0	59.5	70.7	85 : var.	53 : 19th	...	1	...	...	70.2	887.6	880.4	...	4.1	...
›olilo	3,876	69.0	63.9	61	6.0	78.3	59.3	68.8	82 : 17th	54 : 24th	...	...	...	...	...	884.3	880.0	...	4.8	...
ıpleford	5,304	61.2	58.5	57	2.7	69.2	52.2	60.7	75 : 7th	42 : 24th	...	14	...	...	59.2	841.7	880.8	...	6.2	...
ıtali	3,672	68.9	64.0	61	6.0	80.1	59.2	69.7	85 : 10th	53 : 24th	...	...	1	...	69.3	892.2	881.3	890.9	5.7	...
:toria Falls... ...	3,009	73.9	65.5	60	10.4	91.1	61.5	76.3	95 : 19th	53 : 19th	29	...	6	...	75.6	911.1	880.2	...	1.7	...
ınkie...	2,567	76.7	66.0	60	13.4	93.0	67.9	80.5	97 : 19th	63 : 15th	30	...	24	...	79.3	926.0	880.2	...	1.4	...
ercorn	5,407	64.9	61.6	59	3.7	74.2	59.3	66.8	79 : 6th	57 : 18th	...	2	...	...	...	836.7	879.5	...	5.5	...
›ken Hill	3,920	66.4	63.6	62	3.3	79.2	59.5	69.3	83 : 24th	52 : 24th	...	...	...	...	...	883.1	879.3	...	6.2	...
:t Jameson ...	3,620	70.2	66.1	64	4.9	83.5	63.3	73.4	89 : 25th	59 : 21st	12	...	6	...	...	886.6	880.2	...	4.0	...
sama...	4,700	66.7	63.5	62	3.7	77.8	61.9	69.9	82 : var.	56 : 21st	...	2	2	...	...	863.4	879.8	...	...	...
ingstone	3,140	69.3	64.0	61	6.4	89.1	59.7	74.4	94 : 19th	47 : 22nd	26	...	3	...	...	906.1	880.1	...	0.3	...
zabuka Res. ...	3,385	69.1	65.1	63	4.8	81.6	62.3	72.0	86 : 24th	57 : 19th	2	...	2	...	...	899.2	879.2	...	3.4	...
ıgu	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
ika	4,625	65.7	63.2	62	2.8	76.9	60.5	68.7	83 : 24th	55 : 22nd	...	1	...	...	...	861.5	880.0	...	6.8	...
›la	4,140	65.8	63.3	62	2.7	79.4	59.6	69.5	84 : 25th	53 : 19th	...	...	...	...	...	874.4	878.4	...	5.5	

Rainfall in March, 1938, in Hundredths of an Inch. Telegraphic Reports.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total	Normal
30	2	...	...	...	...	...	...	4	24	7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	67	322
57	...	1	...	...	...	...	2	24	4	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	90	606
9	6	3	3	...	...	5	3	...	76	35	...	2	...	...	...	...	...	5	...	...	...	...	...	1	3	12	3	9	2	...	177	803
65	3	...	...	...	...	...	...	44	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	114	503
11	...	...	...	...	...	...	2	...	21	7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	41	297
11	12	13	7	...	...	...	12	9	...	1	15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	80	471
88	47	4	...	...	4	4	39	13	13	15	11	1	4	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	17	...	262	592
22	22	48	11	...	4	33	29	14	46	70	31	8	28	3	...	...	...	...	7	...	...	...	...	...	18	14	...	...	7	...	415	519
44	54	23	6	...	...	16	...	22	14	56	18	20	...	...	...	...	...	...	...	...	...	...	...	...	5	11	...	...	...	...	289	451
25	74	1	...	...	...	...	4	9	30	78	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	227	364
38	18	7	2	...	1	4	7	13	15	18	7	3	1	...	...	...	...	...	...	...	...	...	...	...	1	2	...	...	2	...	139	443

Southern Rhodesia Veterinary Report.

FEBRUARY, 1938.

DISEASES.

Anthrax was diagnosed on the farm Lochinvar, Victoria district. Mortality: Eight head of cattle.

African Coast Fever diagnosed on farms Petrusville and Geluk, Melsetter native district.

TUBERCULIN TEST.

Twenty-one bulls were tested upon importation with negative results.

MALLEIN TEST.

Eleven horses, 25 mules and 12 donkeys. No reactions.

IMPORTATIONS.

From the Union of South Africa: Bulls 20, mules 25, horses 11, sheep 253, pigs 3.

From Northern Rhodesia: Bulls 1.

From Bechuanaland Protectorate: Sheep 1,230, goats 40.

EXPORTATIONS.

To Northern Rhodesia: Oxen 48, bulls 15, cows 9.

To Portuguese East Africa: Oxen 40.

To Bechuanaland Protectorate: Donkeys 12.

To Congo Belge: Pigs 3.

EXPORTATIONS—MISCELLANEOUS.

To the United Kingdom in Cold Storage: Chilled beef quarters, 2,171; frozen boned beef quarters, 1,096; kidneys, 236 lbs.; tongues, 1,168 lbs.; livers, 5,694 lbs.; hearts, 749 lbs.; tails, 502 lbs.; skirts, 1,761 lbs.; shanks, 2,730 lbs.

To Northern Rhodesia in Cold Storage: Beef, 83,380 lbs.; pigs, 112 lbs.; veal, 211 lbs.

To Congo Belge: Beef, 146,705 lbs.; mutton, 532 lbs.; pigs, 1,213 lbs.; veal, 2,256 lbs.

Meat Products.—From Liebig's Factory: Corned beef, 104,040 lbs.; premier jus 2,354 lbs.

G. C. Hooper Sharpe,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-38.

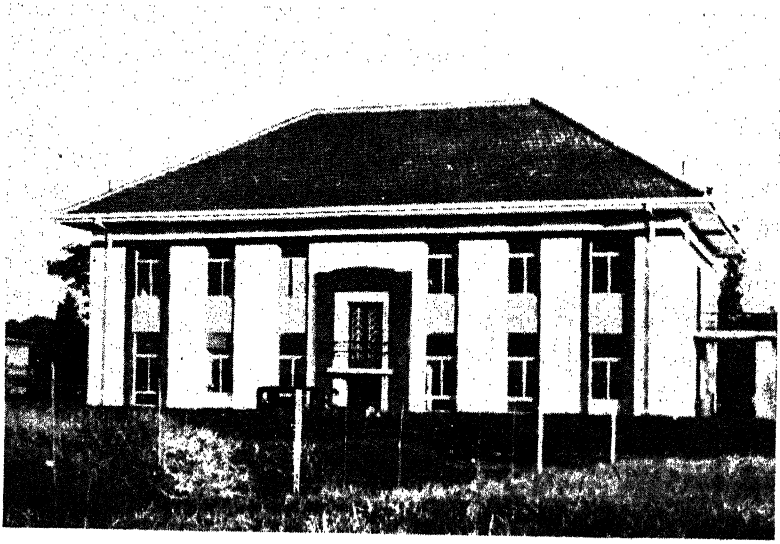
Monthly Report No. 64. March, 1938.

The Red Locust (*Nomadacris septemfasciata*, Serv.) has been reported, in the hopper stage only, from the following districts during the month, namely. Umtali, Melsetter, Bikita, Insiza, Matobo, Lomangundi and Sebungwe, but repressive measures have continued in other districts mentioned in last month's report.

The outbreaks on the whole have been localised, crops have been effectively protected and the hopper bands have been, or are being, destroyed in all accessible localities.

The spraying method has been used exclusively for all larger scale operations in the field, but the baiting method recently developed in the Union of South Africa has been tried out, particularly in reference to hoppers hatching in cultivated lands. The latter method has given good results in certain circumstances, but it is felt that considerably more experimentation is needed before reliance can be placed on it for extensive field operations. Rainy weather appears to affect the results of baiting more than those of spraying, and the weather was very wet during the period when the experiments were carried out. The advantages of baiting for general use are, therefore, considered to be still doubtful under tropical conditions, when operations against hoppers have generally to be carried out during the rains.

RUPERT W. JACK,
Chief Entomologist.



The laboratories of the Chemistry Branch, Salisbury.

THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.
(Assisted by the Staff of the Agricultural Department).

PUBLISHED MONTHLY.

Subscription: 5/- per annum; payable to the Accountant, Department of Agriculture, Salisbury.

VOL. XXXV.] JUNE, 1938. [No. 6.

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, *Salisbury.*

Livestock Improvement Scheme.—Stockowners are advised that applications for assistance towards the purchase of bulls, rams, boars or registered female stock in terms of the above scheme, during the twelve months ending March 31st, 1939, should reach the Secretary, Department of Agriculture and Lands, P.O. Box 387, Salisbury, not later than June 30th, 1938.

The stock improvement scheme has for its object the provision of means by which stockowners in the Colony may obtain financial assistance from the Government, in order to improve their herds or flocks.

The method of management applied to an applicant's herd or flock and the general condition of the animals will be

regarded as the primary factors determining whether assistance should be accorded or not. Special consideration will be given to the condition and growth of the young stock.

A copy of the conditions under which these grants may be made, together with the necessary application form, can be obtained from the Department of Agriculture and Lands, P.O. Box 387, Salisbury.

These grants provide for a contribution by the Government of a certain proportion of the purchase price paid by approved applicants for approved stock. Such stock must be approved prior to purchase by the applicant unless otherwise previously arranged with the Department.

Any stockowner who has stock for sale which is likely to be suitable for this scheme is urged to send full particulars of the animals for sale to the Secretary, in order that the necessary inspection may be arranged and information in regard to these animals may be brought to the attention of enquirers.

Anthrax Vaccine.—Outbreaks of anthrax occasionally occur where there has been no infection for some years, and the only known preventative is by the inoculation of infected animals and of all animals which come in contact with the infected areas. The vaccine used is prepared at the Veterinary Laboratories, Onderstepoort, and on account of the heavy mortality in cattle and the serious danger of human infection the vaccine was, for a time, issued free of cost.

The increasing demand by stockowners, however, meant increased staff and a heavy expenditure, so the Union Government is now compelled to make a charge. This is at present 10s. per 100 doses, and although there are other expenses involved in importing the vaccine, the Government has decided that in future anthrax vaccine will be supplied to farmers at the initial cost, *i.e.*, 10s. per 100 doses. Applications for the inoculation of cattle against anthrax must be made to the Chief Veterinary Surgeon, Salisbury, or to the District Veterinary Officer.

Cashew Nut Oil.—The cashew oil, which is extracted from the shells of the raw nuts during the process of roasting, has many valuable uses. At one time it was employed only by the natives, but much work has been done in recent years with a view to its industrial utilisation. Processes have been devised for using it in the preparation of different kinds of varnishes, insulating coatings, moulding compositions, inks, etc. During 1936 large quantities of the oil were exported from India, principally to the United States and Germany, and one company with factories near Quilon is planning to produce 200,000 gallons of shell oil annually. In view of the growing demand for the oil new methods for its extraction are being developed so as to prevent the large wastage incurred in the ordinary treatment of the nuts.

In India, where the shell oil is sold locally at the rate of Rs. 1—8—0 per maund of 29 lbs., it is in demand as a lubricant for country boats and has the valuable property of preventing damage by white ants when painted on furniture, books, and similar perishable articles. The oil is also used by fishermen as a preservative for their nets. The villagers maintain that cashew shell oil is a valuable specific against leprosy, that dreaded scourge of the East, and there is evidence from medical men in the districts that the oil is efficacious in the treatment of this disease.

Clarified Butter (Ghee) in Africa.—According to a report in the latest number of the Bulletin of the Imperial Institute the manufacture of clarified butter is likely to develop on a large scale in Tanganyika, Gambia and the Sudan. Commercially it is known as clarified butter to distinguish it from the ghee which is commonly prepared by the natives. The Departments of Agriculture in various African Colonies, including Nyasaland, are endeavouring to build up an industry with the assistance of their Veterinary Officers. In the Musoma district of Tanganyika 700 tons of ghee was made by the natives during 1936 valued at £37,450. Modern separators are now in common use by the natives in that Territory. There is a good demand for this product not only in the Territory but for export to the neighbouring countries.

The clarified butter for export is now produced in modern factories which are almost entirely under the control of the United Africa Company, Limited. Cream is collected from the natives and ripened at the factory. It is then put into a container furnished with a water jacket and slowly heated to a temperature of about 80°C.

When the curd precipitates, the fat is filtered through a filter with cotton wool disc. The filtered fat is then placed in a second container, heated to 65°C., and kept at this temperature for about 20 to 30 minutes to evaporate the moisture. The fat is then refiltered into sterilised containers, and after being allowed to cool, is sealed for storage.

It is important that the moisture content should not exceed 0.2%, otherwise the clarified butter turns rancid.

There is a good demand for ghee in Great Britain, present prices c.i.f. London, being from about £65 to £75 per ton, or even higher, according to quality (December, 1937). Quotations have varied in the last few years from as low as £50 to as high as £80 per ton, but the bulk of the business has been done at prices ranging from £60 to £75 per ton. Prices tend to fluctuate with those of New Zealand and Australian butter, since ghee, though not recognised in England as an "edible" fat in the ordinary sense, nevertheless competes with other fats for cooking purposes and ships' stores.

Pyrethrum in Kenya.—An interesting article on this subject by Mr. V. A. Beckley, M.C., M.A., the Senior Agricultural Chemist of the Kenya Department of Agriculture, appears in a recent Bulletin of the Imperial Institute. The growth of this industry in Kenya during the last few years has been remarkable. In the 1933-34 season there were only 35 growers, and with less than 400 acres under this crop, the export was 14½ tons. In the 1936-37 season 341 growers from 4,624 acres supplied the local requirements of about 60 tons and exported in additions 975 tons.

In 1932 it was ascertained by the early experimenters with this crop that it would not flower below 5,500 feet. With

increasing altitude the percentage of non-flowering plants decreased until at 8,500 feet and over all plants produced full crops of flowers. It has been found there that the seed must be used as fresh as possible and that the seed-beds must not be planted too thickly so as to avoid damping off. The most common spacing employed in Kenya it 18 inches by 18 inches, but wider spacing has to be used if the weed growth is likely to be excessive and frequent cultivation necessary.

The propagation of pyrethrum by cuttings is very commonly practised in Kenya. It is much quicker and cheaper, and whereas seedlings seldom flower earlier than six months after planting out, the cuttings produce flowers in from three to four months.

The yield varies according to altitude. At the lower limit of economic production, about 5,500 ft.-6,000 ft., the yield will be about 4 cwts. per acre, although local conditions at this altitude may send the yield up to 6 or 7 cwts. At the higher elevations, 8,500 ft.-9,500 ft., yields of 10-15 cwts. per acre are usual.

In drying pyrethrum the fresh flower loses 75 per cent. of its weight. The removal of this large quantity of water has introduced many problems.

In the early days of the industry, when individual plantings were a few acres only, it was fairly easy to dry the flowers in the sun or under cover. But now, when growers may have as many as tens or scores of acres as once they had acres, different methods have had to be sought.

Aggravating the whole matter is the fact that the main producing areas are in a zone of heavy rainfall and some lie in the mist belt when, during the months of peak production, the countryside is enveloped in mist till well into the forenoon, and the sun may not be seen for weeks on end. Artificial drying under such conditions is essential.

As a result of representations made by the industry the "Sale of Pyrethrum Ordinance, 1935," was enacted. Under this Ordinance an Agency was established through the hands of which all pyrethrum must pass. A Board of Control was

also instituted, and, since every pyrethrum grower is forced to register himself, the Board, being elected by the growers, is representative of the whole industry.

Under the provision of the Ordinance growers must supply estimates of their crops. Upon these estimates forward sales are made. Thus the pyrethrum is despatched to the user without delay. There is no accumulation of stores; the pyrethrum reaches the buyer in as fresh state as is possible.

Another function of the Board and the Agency instituted under the Ordinance is the grading of pyrethrum. At first there were only two grades, based upon appearance. Later, when it appeared that the quality of Kenya pyrethrum was deteriorating, three grades were laid down, depending on the proportion of immature and over-mature flowers.

Notes on Maize Weevil

(*CALANDRA ORYZAE*, L.)

By M. C. Mossop, M.Sc., Entomologist.

In a short paper on an unusual outbreak of maize weevil(1) the present writer suggested, *inter alia*, that in 1937 maize weevil (*Calandra oryzae*, L.) had become apparent in bagged grain earlier than usual, giving rise to fears of a serious outbreak, but that the final result was an infestation of less than average proportions. Not only has it proved correct that the final infestation was comparatively light in stored grain, but the effects were also observed in maize lands during May, 1938, the field infestation being decidedly subnormal.

In correspondence published in the April number of the *Journal*(2), a request was made for figures to serve as an index of the field infestation near shelling dumps and farm maize stores in order to compare different methods of storing maize and of handling shelling dumps. The figures were to be based on a simple technique which was briefly described, and which had been in use for three seasons previously. It is now found, however, that the subnormal field infestation prevailing during the present season is not sufficiently severe to enable significant figures to be collected by the usual technique. Figures obtained by the writer during May were too low for a comparison of the relative importance of different sources of field infestation. In some cases of neglected shelling dumps, where significantly large figures had been obtained previously, zero readings were obtained this year.

The exceptional dryness of the maize in 1937 interfered to a large extent with the prolific breeding of maize weevil until the maize had been able to absorb moisture after the commencement of the rains in November. In consequence there were fewer weevils to infest the lands, with the results described in the preceding paragraphs.

Figures obtained during the present season, therefore, are not only of little value, but may even be misleading. For

instance, the inability to find weevil in the lands this year does not necessarily mean that the method of handling the nearby store or shelling dump has been responsible for the apparent absence of field infestation. But in normal seasons the technique is considered to be adequate, and will, therefore, continue to be used.

The present comparatively satisfactory state of affairs as regards field infestation should not be regarded as a good omen for the coming storage season. Although the initial infestation will probably be less than is normal, the indications are that the maize* contains more moisture than is usual at this time of the year. If this is so, unless the grain dries out rapidly before the warm weather sets in, it is expected that intensive breeding by weevil will commence early in the spring, leading to a normal weevil infestation.

The present position might be turned to some advantage if the grain is dried as much as practicable before being stored. Pigeon-hole stacking as well as any other methods that may be convenient should be adopted. Drying will be especially desirable where grain is stored in bulk in tanks or silos, particularly if these are exposed to the direct rays of the sun. It is believed that the heating of one side of a tank by the sun's rays drives some of the moisture from the grain on that side, and that this settles on the cooler side, giving rise to increased moisture in the grain there. If the grain on the cooler side is not fairly dry, the added moisture may render it sufficiently damp to cause moulds to develop and spoil it. It is desirable, therefore, that grain tanks be either erected under shelter, or else subsequently shaded. In view of our geographical position, protection on all sides is preferable.

REFERENCES.

(1)Mossop, M. C.: An Unusual Winter Outbreak of Maize Weevil *(Calandra oryzae,* L.). *Rhod. Agric. Journ.*, XXXIV., 12, pp. 935-941, Salisbury, Dec., 1937. (Bull. 1050).

(2)Mossop, M. C.: The Maize Weevil Problem. *Ibid,* XXXV., 4, pp. 252-255, Salisbury, April, 1938.

*This applies principally to the Mazoe Valley.

A Note on a Stem Rot of Sweet Peas.

By J. C. F. HOPKINS, D.Sc., A.I.C.T.A., Senior Plant Pathologist.

Wilting and death of sweet peas, which have recently emerged from the soil, occur commonly every year in Rhodesia and are invariably attributed to cutworm attack. In some cases losses may be very high, but nearly always the grower loses an appreciable number of his plants.

Unsatisfactory growth of sweet pea plants has been complained of this season by numerous gardeners, and it would appear that climatic factors have combined to emphasise a common trouble.

In other years wilting seedlings have been examined and found to be attacked by a soil-inhabiting fungus, *Fusarium*, which was not, however, specifically determined.

This season the fungus has been isolated and determined as *Fusarium Solani* var. *Martii* and its action in the plant tissues studied.

Sweet peas, in Rhodesia, will not thrive when temperatures are high, but are yet tolerant to the normal sun temperatures of winter. Early planted peas this season germinated and grew well during a spell of cool rainy weather, but when the seedlings had produced one or two pairs of leaves above the cotyledons, a sudden hot, dry spell lasting for a few days occurred and immediately afterwards the young plants began to wilt.

Seedlings examined in the Plant Pathology Laboratory showed pale brown or cream coloured lesions on the stems at soil level, and a fungus could be seen in the cells of the soft tissues. In advanced cases the stems were completely girdled and exhibited marked constrictions, whilst less severely attacked plants were only affected by a small depression on

one side. In some cases the cotyledons were attacked with the production of small pale spots or else shrivelling of the margins.

The plants were immediately watered with Cheshunt compound and the disease arrested. Some plants died during the next few days and a second application was given, but the majority were not affected any further and have subsequently grown normally.

There seems to be little doubt that *Fusarium Solani* var. *Martii* is capable of causing a stem rot and wilt of sweet peas under the conditions recorded and that the disease can be controlled by watering with Cheshunt compound.

To make Cheshunt Compound—Take

2 ozs. copper sulphate (blue stone).

11 ozs. ammonium carbonate.

Grind each separately—especially the ammonium carbonate—to a fine powder and mix intimately. Place the mixture in an air-tight glass or earthenware container for at least 24 hours, when it will take on a deep royal blue colour.

Weigh out 2 oz. and dissolve in a little hot water. Bring up to 4 gallons (1 petrol tin) with cold water.

This solution may be watered on to very young seedlings in tins without risk of damage and can be used at double strength on less delicate plants, if necessary.

Note.—Difficulty may be experienced in crushing the ammonium carbonate, which is usually bought in hard lumps. A satisfactory powder can, however, be obtained by the use of a prospector's pestle and mortar.

Compost on a Mixed Farm in Kenya.

By J. E. A. Wolryche-Whitmore, Rongai, Kenya Colony.

[Note.—It is hoped that the following article by a Kenya farmer, extracted from the *East African Agricultural Journal*, may be of interest to our readers, particularly those sections describing the types of skid and sweep employed by him for collecting the crop wastes. These labour-saving implements should be of value in this Colony for the collection of sunn-hemp and crop wastes for composting and also in making hay. The skid should be of particular value in collecting maize stalks. It is unlikely that the system of water storage in sumps will be of much assistance to farmers in this Colony, except perhaps to tobacco farmers, who may prefer to make their compost during the dry season. The sumps would, however, require lining to make them water tight.—Ed.]

There seems to be a common belief amongst farmers that composting is not worth the trouble, and that it is expensive and complicated. Several years of experience of composting at Rongai have satisfied me that the cost can be kept quite low and that the results are very encouraging.

Composting on this farm at Rongai was started same four years ago, and was intended to follow somewhat the Indore lines, but with a less elaborate system of measurements to suit the type of labour employed. Some 300 tons were produced the first year, and during the last twelve months we have made over 1,200, and we hope to work up to 2,000 tons. Two farms of about 2,700 acres are worked as one, and have 1,100 acres under main crops and some 250 under a weed fallow.

The first compost made was at the milking shed and one ox *boma*, both of which are situated some distance from the

water and the nearest fields, and it was soon apparent that much extra labour was wanted to get water and roughage to the compost yards. We have gradually been altering our methods, and now are trying to arrange that all our fields have water near them, and we are making most of the compost within 60 yards of the edge of the field. We are gradually broad-base terracing the whole farm, and we collect the water off the terraces into small dams dug with dam scoops. These dams should, where possible, be a minimum of 8 feet deep, so as to provide water through the dry weather when the compost-making is in full swing. Depth rather than area should be the aim.

We have on this farm about 190 working oxen, about 70 cows in milk, and a dry and young herd of 100. The manure from the cows is only available for the time when they are waiting to be milked, but the rest of the cattle are in the yards about ten hours out of the twenty-four. We employ a permanent gang consisting of a cheap head boy and eight boys whose sole job is to keep the cattle supplied with bedding, to remove it and make and turn the compost. In addition, for at least six months of the year, we have two half teams of oxen, with four boys each, engaged on bringing the roughage to the yards.

The roughage consists of any form of straw left behind the combine, maize stalks, maize cobs, grass, Napier grass, weeds, Mexican marigold; in fact, anything we can get hold of. We are now making compost at six points on the farm, and as the land gets terraced hope to have water at about 550-yard intervals alongside the fields. The general lay-out will be to site the dams just far enough from the edge of the field to allow for a dump of roughage next to the edge, a cattle *boma* about 15 to 20 yards square, and a compost yard about 15 yards wide between the *boma* and the dam.

Loading straw and maize stalks on to wagons is slow work, and we are now gradually getting away from them and using skids and sweeps, both of which save time and labour. Where the land is fairly smooth, a skid measuring 18 ft. by 14 ft., made of gum poles, will be found much quicker than a wagon. The frame is of four poles lengthways and five across, bolted at all joints with half-inch bolts and further stiffened with

two diagonal stays at each end. A few wires may be stapled on top if the roughage is rather short. Two ropes, about 45 feet long and about one inch diameter, are attached to the front end and allowed to trail over the frame, being kept apart by a pole about 7 feet wide at the rear end. From half a team to a full team are required to pull the skid, according to the weather and the roughness of the ground.

This skid is dragged alongside the wind-rows and boys throw the roughage on to it. When the load is completed and drawn to the dump the oxen are unhitched from the front and attached to the two ropes, which are now brought from the back over the top of load. The load is rolled off complete as the oxen go forward. The oxen are again unhitched and can draw the skid backwards from the dump. When making hay, a skid can bring up 12 to 15 tons per day with a haul of up to 300 yards.

When the ground is more uneven and terraces have to be crossed a sweep on the lines of the tractor hay sweep employed in England can be easily made on the farm, and we have had one of these working for two seasons with oxen.

A frame is made, preferably of sawn timber, about 4 in. x 4 in., but gum poles will do; length 4 ft., width 12 ft., bolted at the corners. An upright, about 3 ft. high, is mortised into the centre of the two 4 ft. sides, and is stayed by wires front and back. A top bar connects these two uprights. Two wheels, about 24 in. diameter, are mounted towards the outside of the frame, one on each side on short axles, so that the frame balances on them. Under this frame, and at about 15 in. intervals across it, are bolted the long prongs for the sweep. These are of gum poles, 10 ft. long about 3½ in. diameter, tapering to 2 in. and shaped to a point. At the rear of the frame is bolted a stout pole, about 14 ft. long over all, which is used to help steer the machine. The balance should be arranged so that the sweep points rest lightly on the ground and can be raised easily by depressing the steering pole.

Two long chains are attached, one on each side of the short sides of the frame; they should be sufficiently long to allow the oxen to keep well clear of the points. Four oxen

are attached on each side, and are lead on each side of the windrow, the sweep picking up the windrow as it goes along.

The boys who lead the oxen have to take care that both lots go the same pace. A boy at the back holds the pole and can direct the machine to a certain extent. It takes the boys some time to get into the way of using the skid, but once they do so they can move a lot of roughage in the day. We have found it quite economical up to 500 yards haul. Occasionally a point is broken, and it is as well to have a spare ready drilled, as this can be put in at once by removing the two frame bolts.

Our methods of making compost are fairly primitive, but the result after three or four months is a very serviceable article, though not so finely broken down as the Indore compost.

The yards have about six inches to a foot of roughage thrown in to them, and the cattle break this down for a few days, when possibly another layer is added and broken down. This is then carried out on stretchers to the pits or heaps, where it is loosened and spread in layers about 6 in. deep by 15 ft. by 15 ft. Wood ashes and some of the earth from under the cattle are added, together with a little compost from an earlier heap. We are now also using either bone meal or Seychelles guano at the rate of about 15 lb. per ton of material, but a lot of our compost has not had this.

The layer of material is now well watered, the water being thrown on with a sweep of a *kerai* (mason's pan), and further layers are added up to about 4 ft.

Each heap has a numbered peg and is recorded in a book kept by the head boy, under the headings of the date of making the heap and first, second and third turnings, and date of taking to the field. It is thus easy to keep track of each heap. Under favourable conditions, the gang of boys can make one new heap and turn one or two more each day. This, of course, depends on how packed and wet the material in the yard is. As far as possible we try to mix the various kinds of roughage, but quite often have only maize stalks.

When is comes to spreading on the field we use an American manure-spreading wagon, which we find very much more satisfactory than spreading from heaps dumped in the field. We have had one wagon in use for ten years. They cost about £50, but are very well worth it, as the manure is spread quicker and more evenly, whilst the loading is much faster than when using a cart or wagon. Our wagon takes about 1½ tons, and eight trips per day to a distance of a mile is not out of the way. The rate of application can be altered in a moment by a lever.

From ordinary farm estimates it appears that one ton of compost (without phosphates) will give an extra yield approximating to one bag of maize or its equivalent in other crops. This is being borne out by the experiments on the Government plots on this farm, where applications of compost in 1935 gave the following results:—[1]

	Yield in bags per acre.	Per cent.
Control	13.3	100
3 tons...	16.6	124.7
6 tons...	17.8	133.7
8½ tons	18.9	142.1

In 1936 the experiment was replanted without any further addition of compost, and results were as follows:—

	Yield in bags per acre.	Per cent.
Control	13.49	100
3 tons...	13.84	102.6
6 tons...	15.03	111.4
8½ tons	16.71	123.8

As our compost is costing us well under Sh. 1/50 per ton, it will be seen to be a very profitable investment; this, of course, does not take into account the added phosphates. The usual objection to farmyard manure, that it brings in weeds and couch, does not apply to compost, as the high temperatures reached during the fermenting process effectively destroy weed seeds and also Smut and Pink Ear Rot spores.

[1] East African Agricultural Journal, Vo. II., No. 4, p. 255, 1937.

Report of the Tobacco Research Board

FOR THE YEAR ENDING DECEMBER 31st, 1937.

By Chas. K. Brain, M.A., D.Sc., Director of Agriculture, and Chairman of the Tobacco Research Board.

(*Continued.*)

PLANT PATHOLOGY. (Dr. G. M. Wickens).

Parasitic Leaf Spot.—The following parasitic leaf spot diseases occurred on the Station during the season 1936-37:—Frog-eye, alternaria leaf spot, angular spot and (very rare) shot-hole caused by a species of *Phyllosticta*.

Frog-eye was generally prevalent, its severity being attributable to two factors—high rainfall (in particular the period 25th January to 27th February, when rain fell on every day but three, totalling almost 17 inches, with further spasmodic rains in March and early April), and insufficient barn accommodation which caused delays in reaping.

Alternaria leaf spot occurred rather generally, but infection was very slight. Just before the first picking, records were taken of the occurrence of alternaria spot in the 108 plots of the Plant Physiologist's experiment on "The effect of Phosphorus, Nitrogen and Potash upon the yield, price and total value in tobacco." The heaviest infection on any one plot of about 160 plants was one or two spots on each of six plants, and infections were found only on plots situated on the lower-lying north-east corner of the experimental area. Further observation showed that in spite of a protracted rainy period no epidemic spread of the disease occurred. Infections were too slight to permit of the drawing of any valid conclusions with regard to the relative susceptibility of "heavy" and "light" plants.

Angular spot was first recorded early in January, two very small outbreaks occurring. One was in a plot of the Plant Physiologist's experiment referred to above, and the other in one of the Tobacco Research Officer's rotation trials. In each case the affected leaves were removed and copper lime dust applied to the affected and surrounding plants. No further trouble was experienced until the beginning of February, a few days after the onset of the prolonged rainy period mentioned previously, when some further spread in the above plots was observed, and a slight outbreak also occurred in one of the Plant Breeder's observation plots of Giant White Stem Orinoco. Affected leaves were removed as precautionary measures and in the normal process of reaping, and in spite of prolonged rainy conditions no serious spread of the disease occurred.

Spraying versus **Dusting.**—During recent years, with the production of improved machinery and of dusts of greater fineness, the popularity of treating plants with dry fungicidal powders as opposed to liquid sprays has steadily grown. In general the main advantages and disadvantages of dusting as compared with spraying may be summarised as follows:—

1. **Advantages.**

   (*a*) Dusting requires less time, and less labour, for treating a given area.

   (*b*) Dusting can be done when the plants are damp with dew, or shortly after showers and in lulls between storms. Spraying can be done only when leaves are dry.

   (*c*) No water supply is required.

2. **Disadvantages.**

   (*a*) Dusting materials are more expensive than those for spraying. Against this, of course, must be set the cost of the extra labour required for the latter.

   (*b*) Deposits left after dusting are usually not as adhesive as those from spraying.

Considering the conditions of tobacco growing in Rhodesia in particular advantages of dusting in seed-beds as against spraying are possibly not sufficiently great to compensate for the poor adhesiveness of the deposit compared with that left by an efficient spray or wash. But in the field it is the writer's opinion that both practical and economic considerations are so antagonistic to routine spraying, that if circumstances require the application of a protective fungicide to any appreciable area dusting must be adopted.

With the foregoing considerations in mind, during the season under review two spraying and dusting trials were laid down with the following objects:—

(*a*) To assess the relative value of dusting with copper lime dust and spraying with a wide variety of fungicides, in seed-beds and in the field, against frog-eye and any other parasitic leaf spot diseases that may naturally occur, and

(*b*) to compare the relative merits of various fungicides from the points of view of liability to scorch the leaves, ease of preparation and application, covering power, and capacity of the deposits to adhere to the leaf surfaces.

Discussion of Results and their Practical Application.

Field Spraying and Dusting in General.—In the first place it should be noted that in the experiments described no appreciable control of frog-eye on reapable leaves resulted from any spraying or dusting, except a slight (and almost certainly uneconomic) control from the dusting on 27th January, 1937, and fair measure of control from certain sprays and washes, applied at the very heavy rates of 100 gallons per acre for spray and 200 gallons per acre for washes to rather large plants about a month before the first reaping. It need hardly be emphasised that such a rate of spraying is economically quite out of the question. There is the further point that in spite of heavy rainfalls following the spray application, spray deposits were still only too visible on the reaped leaves of plants washed with the very retentive home-made Bordeaux-monkey nut oil emulsion, rendering them commercially valueless. It is likely that if only light rains had been experienced in this interval, as might well happen in other seasons, leaves

sprayed with many of the other preparations might also in the same way have been commercially spoilt. On the grounds of danger to there being visible deposit on the leaves when reaped, and from practical and economic consideration, control of frog-eye by the application of sprays to reapable leaves is quite out of the question under Rhodesian conditions.

Except in so far as benefit might accrue from a resultant checking of increase of infestation by the causative fungus, the spraying of small plants in the field can have no effect on the incidence of frog-eye and barn spot on the cured leaves. In any case, possible bulking up of infestation can be much more simply and cheaply checked by priming off and destroying the small leaves before they reach the stage of carrying spots from which spores are being produced. It may be stated that there would appear at present to be no need at all to have recourse to the laborous and expensive operations of dusting or spraying in the field for the control of frog-eye or barn spot.

But for the control of other parasitic leaf spot diseases, in particular in districts of rather heavier soil where it is known that one or other of these diseases, if unchecked, may assume a serious epidemic form, spraying or dusting in the field may be of considerable value.

Spraying versus **Dusting in Seed-beds.**—The earlier in the season that infection of alternaria spot, angular spot or wildfire occurs the greater the chance that they may cause in the end considerable damage. For this reason (and also because treatment of the beds is relatively simple and inexpensive) regular routine spraying or dusting of seed-beds is desirable as a form of insurance.

The most satisfactory results have been obtained by using commercial Bordeaux mixture in the form where the copper sulphate and lime are supplied in separate packages.

Frog-eye and Barn Spot.—In considering control measures for these two diseases, or rather two manifestations of one disease, the following important facts must be borne in mind:

1. For a disease such as this to reach severe proportions, two conditions must be satisfied.

(*a*) Conditions must be favourable for attack of the host by parasite, and

(*b*) there must be present in the immediate vicinity of the host, abundant infestation.

2. The only known means by which infestation on the farm is rapidly increased is by the production from spores from spots on the leaves, and these spots only develop on leaf tissues that have reached a certain stage of maturity.

The breeding of resistant varieties or selection of resistant strains, spraying or dusting, and modifications of climatic conditions immediately surrounding the leaf surfaces by altering the spacing of the plants and by other methods, are the usual lines of control of parasitic leaf spots in general by imposing conditions unsuitable for parasitic attack, is sought.

At the present time there does not appear to be much hope of developing varieties or strains of tobacco of appreciable inherent resistance to frog-eye and barn spot, and spraying at any rate can be eliminated as a possible means of control for reasons previously put forward.

As stated previously, experimental results have given a suggestion that the disease may be modified by the degree of spacing of the plants. Since evidence is growing that, neglecting the disease factor, more plants per acre than given by the present usual 3 ft. x 3 ft. spacing may prove profitable, the question of the influence of this factor on frog-eye and barn spot must be accurately determined. Experiments along these lines are planned for the coming season.

But by far the greatest promise of economically controlling the disease lies in two methods—reduction of infestation by periodic removal and destruction of unwanted lower leaves for curing at a stage sufficiently mature for curing but before they have developed frog-eye spots.

From results of experiments carried out last season it is plainly evident that there exists, for each leaf, a stage of maturity at which negligible frog-eye infestation is apparent but which yet is sufficiently advanced for the leaf to be curable. Leaves cured at this stage, in spite of very abundant

frog-eye infection in the land and conditions ideally suited for spread of the disease (the leaves were picked towards the close of the protracted rainy spell referred to previously) came out of the barn relatively clean.

The question of how high to prime—that is, how much bare stalk to leave—is frequently raised. But this question completely misses the point. After the plants are set out in the field, the first leaves that develop remain small and are commercially valueless. The object of priming is to remove and destroy these useless leaves before they reach the stage of maturity at which frog-eye spots develop. After the development of these small leaves there is a rather sharp transition stage to leaves suitable for curing. These ripen progressively upwards, and if every leaf is picked at the right stage it seems evident that whatever the climatic conditions a crop of clean leaf should be obtained. Obviously then the only economic height of priming is that given when the useless leaves are removed but all commercially valuable leaves retained and in due course reaped and cured.

The removal and destruction of all unwanted leaves before they become nurseries for the rapid propagation of the causal organism, and the reaping of every leaf in the field at the specified stage, are, of course, counsels of perfection. It remains to consider what factors effect the degree to which this ideal can in practice be approached.

A factor of very considerable importance is that of uniformity of plants in the field. If plants of widely varying stages of development are present, it will obviously be necessary, if the object of priming is to be satisfactorily accomplished, to put labour through the fields at much more frequent intervals than if the crop is uniform. This not only entails more expense, but increases the possibility of appreciable spread of mosaic.

But the most important factors are the availability of labour and of barn accommodation. Owing to lack of either or both of these, it frequently happens that a field is not reaped until as many as three or four leaves per plant have ripened, and of these the lower leaves at least are abundantly infected.

Controlling frog-eye by increasing the frequency of reaping in the field of tobacco demands rather more labour, and on many farms more barn accommodation. The writer considers that, taking the Colony as a whole, the increased cost would be very many times outweighed by the enhanced value of the crop. For the coming season, experiments are planned to indicate the value of the suggested control measures and to determine how far in practice the ideal may economically be approached.

Mosaic.—Of the diseases affecting tobacco in Rhodesia, none is the subject of such confusion and uncertainty among farmers as mosaic. This is perhaps not surprising, since so much stress has been laid on native snuff as a source of original infections, and the operation of priming as a means of spread that the possibility of there being other important sources and methods of dissemination has been rather overlooked. Frequently it happens in practice that occurrences and spread of the disease cannot reasonably be explained on these lines: an example of this occurred on the Station during the past season, as will be indicated later.

In no seed-beds was any mosaic disease visible at the time that seedlings were removed for planting out. This freedom from visible disease at this time was undoubtedly due to somewhat thin sowing of the beds so that no later thinning was necessary.

Some two or three weeks after the beds had been picked over for planting out, an appreciable proportion of the seedlings left in the beds were seen to be infected, certainly largely if not necessarily entirely as a result of handling during picking. As the transplants "came away" in the lands a proportion was seen to be infected. In many cases these early infections were rogued out, and fresh seedlings, from untouched beds where possible set in their place.

In spite of thorough application as far as practically possible of the usual precautionary measures—frequent washing of hands at seed-beds and in the lands, and separate priming of visibily diseased and healthy plants—with incidently more supervision than is usually available on the farm, considerable mosaic was present in the lands. In one

land of about 4½ acres where accurate counts were taken, 23% of the plants had become infected before topping. This land was by no means the most affected.

Either, therefore, the above methods are in practice far from completely efficient, or there exist other sources of infection and means of spread of the disease, not controllable by these methods. Before complete control measures reasonably applicable under Rhodesian conditions can be worked out it is essential that the relative importance of all possible sources of infection and means of spread be known.

A. **Possible Sources of Infection.**

1. Perennial weed hosts.
2. The soil.
3. Uncured field refuse.
    (*a*) Infected roots left in the soil.
    (*b*) Infected leaf and-stem refuse left lying about.
    (*c*) Native snuff.
4. Cured leaf.
    (*a*) Tobacco scrap from barns, grading sheds, etc.
    (*b*) Processed tobaccos—cigarettes, pipe tobacco, snuff, etc.

B. **Possible Agencies of Spread.**

1. Operations involving handling of the plants.
2. By implements during cultivations.
3. By insects; in particular leaf chewing insects.

NEMATODE INVESTIGATIONS (J. C. Collins).

Examination of River Water.—In the annual report for the season 1935-36 reference was made to a series of experiments being carried out to determine whether or not water from certain streams is a source of introduction of the Tobacco Root-Knot Nematode (*H. marioni*, Cornu) to tobacco seedbeds and thence to the lands. The experiment has now been completed and the conclusions arrived at as follows:—

Conclusions.—(1) It is to be inferred from the results obtained that water from boreholes and wells does not contain *H. marioni*.

(2) The results obtained prove that river water, at least when containing silt and soil scraped in from the banks of the river, is a source of infection. Although only a small percentage of plants showed signs of infection, the results may be regarded as significant when it is realised that the number of eggs produced by a single female *H. marioni* is very considerable indeed. Godfrey and Oliveira claim to have found as many as 1,200 eggs in a single egg-mass where host, soil and temperature conditions were optimal. Further, it must be remembered that pathenogenetic reproduction is quite normal and regular. A knowledge of these facts makes it easy to appreciate what an important source of trouble even a single female *H. marioni* is capable of being when introduced to a tobacco seed-bed.

It must also be realised that the amount of water used in the experiment was negligible compared with the tremendous volume used by a tobacco grower during the seed-bed season. It would be reasonable to expect, therefore, that if a few *H. marioni* are found in a few gallons of water there will be many more in thousands of gallons.

The fact that eelworm occurred, not in clear running river water, but in river water containing silt and soil washed and scraped in from the banks—and bearing in mind that *H. marioni* is capable of being drowned if kept in water for two weeks or more and that therefore water is not its habitat—tends to show that the eelworm must be scraped into the water from the banks where they are living on the roots of weeds.

A survey must be made of the vegetation growing on the banks of rivers, and certain weeds have been found to harbour *H. marioni*.

A possible and cheap measure of control suggested by these findings is to erect a bridge or walk leading well into the river, and so constructed that natives can draw water for the seed-beds from the centre of the river where it is clear, and avoid disturbing the earth on the banks.

There is the possibility, however, that they might be induced, when white supervision is lacking, to avoid making use of the bridge and instead fill their buckets from near the banks; to prevent such practice the banks of the river adjacent to the pools from which the water is being drawn should be fenced off with bush poles.

As an additional inducement to draw water from the centre of the river, the bridge should be made sufficiently strong and sufficiently wide to dispel from the native mind any fear of accident, and should be constructed at such a height as to render the drawing of water an easy operation. When determining the optimum height at which the bridge should be built, consideration should be paid to the maximum height which the river attains at that particular place.

Equal success might be expected from a pump situated in the centre of the river and fitted with pipe lines leading to a reservoir in the seed-beds site.

This latter method, though being more expensive, would undoubtedly be the more convenient.

Note.—It may be well to note here that although river water has been shown by the above experiment to be a source of introduction of root-knot nematode, it is by no means the only source. The writer has observed infestation on first year land on a farm where the seed-beds received water from a borehole, and where close examination of the seed-beds showed them to be free of the pest. Further, as there was no possible chance of infection having been washed on to the land in question from some other infected area, the most feasible suggestion is that eelworm were already in the land, living on weeds, before the tobacco was planted.

Treatment of River Water.—(*a*) *By means of Chemicals.*—In this connection various chemicals have been tried, including potassium permanganate iodine, sulphate of copper, alum, calcium hypochlorite, phenol formaldehyde and Kerol. None of them is suitable from the practical and economic point of view.

(*b*) *By means of Sand Filters.*—Preliminary experiments have been carried out to test the efficiency of filtering infected water through sand filters. Sand of varying degrees of

coarseness has been tried, and it is found that though a less depth of fine sand is required than of coarser sand, the fine tends to become too compacted after relatively little use and greatly retards the rate of flow of the water. Coarse sand (building sand) gives satisfactory results when used at a depth of 30 inches.

Coarse sand to a depth of approximately 30 inches, with a layer one inch thick of fine sand super-imposed, has not proved superior to the coarse alone, for before long the fine particles get washed deeper down into the coarser and no appreciable difference can be noted.

It now remains to design some suitable type of filter which can be built relatively cheaply on the average farm. It will also have to be determined as to how often the sand will require to be changed when the filter is used on an extensive scale. Perhaps a chemical could be found, the use of which would obviate the necessity of changing the sand.

Chemical Treatment of Infected Soil.—Barium fluosilicate (11 ozs. to 16 sq. yards), Seekay soil fumigant (a heaped teaspoonful in holes 18 inches apart) and sodium cyanide at the rate of 600 lbs. per acre were tried for treating infected soil, but none of these treatments was effective in killing the eelworm.

Notes on Trap Crops.—(1) Both sunflower and kaffir beans are very satisfactory as trap crops, as they germinate readily even under relatively poor moisture conditions.

(2) Although both crops are highly susceptible to attack by the tobacco root-knot nematode, sunflower is to be preferred as a trap crop, because (*a*) its type of root system permits of it being more clearly or wholely removed from the soil, (*b*) the presence of nitrogenous nodules on kaffir bean is liable to confuse the farmer who is not perfectly familiar with galls produced by eelworm.

(3) Four natives can carefully uproot eight acres with hoes in an eight-hour day. This rate of working, of course, depends largely on the density of the trap crop, moisture of the soil and texture of the soil.

(4) The heads of the hoes should be large so that the native can dig deep down into the soil and avoid cutting the roots.

No conclusive results can, of course, be obtained until next season, when each of the plots will be planted with tobacco for purpose of comparison.

Tobacco as a Trap Crop.—A plot 1/20 acre in extent and 100 per cent. infestation was, for observational purposes, planted to tobacco as a trap crop.

The tobacco was planted on the flat at a spacement of 18 inches by 16 inches, and after an interval of 18 days the plants were carefully removed. The infestation was found to be 100 per cent.

Thirty days later the plot was again planted with clean tobacco seedlings on the flat and at the same spacement as before, and the infestation count made on the 21st day, when all the plants were carefully uprooted, gave the astounding figure of 2 per cent., *i.e.*, a reduction in infestation by 98 per cent.

Four days later, however, the plot was check-rowed at thirty-six inches with clean seedlings planted on ridges. A count of 64 days later revealed the infestation to be 46 per cent.

It was not possible to make further plantings owing to the lateness of the season.

General Remarks.—Tobacco from the point of view of a trap crop is not a satisfactory plant owing to a number of reasons:—

(1) It is so much dependent on rain at time of planting that only very limited number of the plantings can be made in the course of the season.

(2) It has to be planted out and therefore a more expensive proposition than a crop such as sunflower or kaffir beans whose seed can be easily broadcast, and germinates readily even under relatively dry conditions.

The additional expense is not only incurred in the actual planting operations, but also in the production of seedlings in seed-beds.

(3) Unless very closely planted it does not afford as dense a cover as sunflower.

(4) Should the young transplants be coming away well and be making promising progress, there is the danger that the grower might become reluctant to uproot and destroy them and by so doing he would be increasing the eelworm population of the soil instead of reducing it.

The only point in favour of tobacco as a trap crop is the readiness with which it becomes infested; but in this respect sunflower may be considered its equal, and this latter is an easier and a more economical crop to grow.

Rotations.—The rotation and cultural practice experiments recorded last year have not reached a stage at which results are yet available.

Determination of Host Range.—A large number of plots which the survey of degree of infestation carried out last season had shown to be severely infested with eelworm, were sown this season to a variety of crops with a view determining which of these crops may be considered resistant and which are hosts. The following are the results obtained during the current season.

Plants attacked by *H. marioni.*

Kaffir beans (*Vigna catjang*).
Munga.*
Pigean pea (*Cajanus indicus*).
Soya beans. All varieties commonly grown in this country, including Biltan, Black Non Shatter, Brochete, Brown, Cayuga, Dixie, Dunfield, Goshen, Green, Herman, Mammoth Otoxi, Rokuson, Selictitous, Virginia, White Non Shatter. (The variety Laredo is reported to be resistant.)
Sunflower.
Tobacco.

Plants not attacked by *H. marioni.*

Cowpea.—Monetta (almost invariably resistant), Brabham and varieties of Victor and Iron.

Grasses.—Gonya Grass, Natal Red Top, Purple Top, Buffel, Rhodes Grass, Rhodesian Sudan Grass, and Teff.
Kaffir Corn.
Kudzu Vine.
Maize.*
Munga.*
Pea Nuts.—Valencia, Virgina Bunch, Masumbika, Jumbo.
Soya Bean.—Laredo.
Sunnhemp.
Rapoko (Grain).
Velvet Beans.—Somerset.
Vivi.
Wintersome.

In addition to growing the above crops on experimental land, the writer continued his survey of weed hosts, and had opportunity of observing on farms that he visited, other plants that are hosts of *Heterodera marioni*. These include:—

Antirrhinum, or Snapdragon.
Balsam.
Beans.—Kaffir (*Vigna catjang*) and garden varieties.
Cabbage.
Carnation.
Carrot.
Cauliflower.
Chrysanthemum.
Cosmos.
Lettuce.
Peas.—Garden pea (*Pisum sativum*, L.).
Petunia.
Potatoes.

The following is a list of native weeds (the weeds were identified by Dr. C. K. Brain, to whom due acknowledgement is made) that are hosts of *H. marioni*:—

Aerva leucura, Moq.
Aeschynemone.
Amaranthus.
Amaranthus graecizans, L.

Cleome monophylila, L.
Conyza.
Gynura cernus, Benth.
Hybiscus canobinus, L.
Orthosiphon bracteosus, Bak.
Polygala abyssinion, Fres.
Senecio.
Vernonia.

Maize and Munga.—A phenomenon of great interest is that maize which is universally referred to as being one of the crops most resistant to *H. marioni*, was observed by the writer to be attacked on a farm in the Darwendale area. Diseased plants were considerably stunted in growth and produced few or very small cobs. Generally speaking, the galls were not easy to detect, although on sound roots they showed up quite well. This is the first instance on record of maize being attacked by *H. marioni* in Rhodesia.

On this same farm munga was also found to be attacked. No reference can be found in literature of this crop being hitherto reported in any country as a host of *H. marioni*. It was only on one particular field that infestation was observed, and the infestation here was not localised to any particular area but spread throughout the field.

Another interesting point is that munga was one of the crops included by the writer among those he was trying on the experimental plots to see whether or not they were hosts. In these trials the munga was grown in a plot the nematode infestation of which was known to be 100%. Random samples (25 per cent. of the crop) were carefully examined, but not a single plant was found to be attacked.

The munga in the field in question at Darwendale showed exceptionally marked dwarfing, the average height of plants being about four to six inches with only an occasional plant reaching normal height of four feet.

1937-38 Programme of Work.—The following outlines give the programme of work planned for the present season as approved by the Tobacco Research Board:—

CULTURAL INVESTIGATIONS (H. F. Ellis in charge).

The following are to be continued:—

(*a*) Topping trials.
(*b*) Spacing trials.
(*c*) Time and method of application of fertiliser.
(*d*) Rotation trials.

Curing Trials.—Tests to be carried out in the curing chambers to investigate different methods of colouring, ventilation, etc., using ethylene and acetylene.

Complex spacing, fertiliser and variety trials in conjunction with Messrs. Moffett and Thorpe.

Mulching Trials.—From half to one acre of first-year land to be planted on the flat and mulched with at least two tons (dry weight) of grass mulch to the acre. The mulch to be applied after the first cultivation and compared with a similar area of new land treated in the ordinary manner. The chemist to collaborate in keeping exact records of physical and chemical condition of these two areas over a series of years.

PLANT BREEDING INVESTIGATIONS (Dr. A. A. Moffett in charge).

(*a*) *Selection.*—Approximately 40 strains or single plant selections will be tested in a single complex experiment.

(*b*) *Testing of New Varieties.*—A large number of varieties previously tested have been discarded. The remainder, with new importations, will be grown in observation plots from bulked selections.

(*c*) *Nicotine Selection.*—The strains of White Stem Orinoco previously used in this experiment have proved to be unsuitable and have been discarded. New selections will be made in conjunction with burning tests, etc.

Mosaic Resistance.—This work shows considerable promise. Next season only the progeny from Jamaica Wrapper x Ambalema will be used.

Cytology.—Studies on the degree of structural hybridity in strains varietied will be continued, as considerable information can be obtained on the variability occurring in tobacco from cytological observations.

Combined Experiments.—A series of combined experiments has been planned in conjunction with other technical officers.

TOBACCO PLANT PHYSIOLOGY (Mr. H. C. Thorpe in charge).

(*a*) *Fertiliser Experiments.*—The investigations concerning varying amounts of nitrogen, phosphorus and potash upon the yield and quality of tobacco have proved of great interest and will be continued.

(*b*) *Tablet Fertiliser.*—This experiment is to be continued for a further season. The following are also to be continued:—

Sources of nitrogen with and without lime.

Minor elements.

Trials of commercial fertilisers.

Rhodesian *versus* American fertiliser application.

The coloured seed-bed cloth experiment and the Urease experiments are being discontinued, as they have given no results.

Size and Shape of Plot.—An experiment is to be carried out in conjunction with the Plant Breeder to ascertain the most suitable size and shape of a plot for tobacco field experiments.

PLANT PATHOLOGY (Dr. G. M. Wickens in charge).

(*a*) Spraying *versus* dusting of seed-beds.

(*b*) Frog-eye and barn spot. The influence of the following factors on their development:—

1. Spacing and variety.
2. Field hygiene.
3. Frequency of reaping.
4. Various priming practices.

(*c*) *Mosaic.*—Influence of the disease on yield and quality of the leaf.

(*d*) The chances of plants set in hills from which mosaic plants have been rogued themselves developing the disease.

(*e*) The economic value of roguing mosaic plants and replanting at varying percentages of original infection.

(*f*) The relative efficacy of various possible methods of reducing the chances of spreading mosaic from plant to plant when priming.

CHEMISTRY (H. M. Murray in charge).

(*a*) A full analysis of cured leaf samples grown in different districts.

(*b*) Investigations of seasonal distribution of nitrogen in soil. Comparison of virgin, second year, etc., soils as to plant food content (and possibly minor element content) and physical characteristics.

(*c*) Small scale lysimeter investigation of N.P. and K availability and loss, under standard fertiliser treatment.

(*d*) Investigation of the effect of ploughing under different green manures on soil nitrogen and humus content (in conjunction with Mr. Ellis).

(*e*) Analysis of approximately 400 samples of leaf for N., P., K., Cl, nicotine and resin (for Messrs. Ellis, Moffett and Thorpe).

(*f*) Analysis of approximately 250 samples of sprayed leaf for copper content (for Dr. Wickens).

BIOLOGIST. NEMATODE INVESTIGATIONS (J. W. H. Hovy, M.Sc., in charge).

(*a*) Filtration of infected river water.
(*b*) Trap cropping.
(*c*) Rotation.
(*d*) Cultural operations.
(*e*) Determination of host-range.

Finances.—The estimates for the year ending 31st March, 1937, was £5,756, the amount actually spent was £5,720 7s. 6d., and the amount charged to the Tobacco Research Trust Fund was therefore £360 3s. 9d.

The estimates for the year ending 31st March, 1938, is £5,876, and it is therefore anticipated that a sum of £438 will have to be met from the Trust Fund.

The amount standing to the credit of the Tobacco Research Trust Fund on January 1st, 1937, was £1,561 4s. 0d., the revenue from 1st January, 1937, to 1st December, 1937, amounted to £629 17s. 6d., making the total £2,191 1s. 6d. The payments made during this period amount to £360 18s. 9d., leaving a balance of £1,830 2s. 9d.

It will be noted that no serious call has yet been made on the Trust Fund. The Government has decided, however, to constitute the Tobacco Research Board as a body corporate at the next session of Parliament. This will undoubtedly mean that the Board will have to rely to a greater extent on its own resources and contributions from outside sources will be absolutely essential if the research work is to be developed to meet the needs of the industry.

Acknowledgments.—Owing to an unfortunate oversight a contribution to the Trust Fund from Messrs. Gallaghers, Ltd., in December, 1936, was not adjusted before the end of the year, and therefore not acknowledged in the report published a year ago.

The Board wishes to record its appreciation and thanks to the following for contributions to the Trust Fund during 1937:—Messrs. the Rhodesia Tobacco Association, Mashonaland Tobacco Company, Andrew Chalmers & Co., Ltd., Gallaghers, Ltd., Imperial Tobacco Co., Ltd., and United Tobacco Cos., Ltd.

The Board wishes to record its appreciation of the able and willing manner in which all the staff on the Trelawney Research Station have carried out their duties during the year.

Pruning of Plantations.

By R. H. Finlay, B.A., Oxon., Division of Forestry.

There appears to be a considerable amount of misunderstanding regarding the pruning of young plantations and faulty treatment is not infrequently observed. It is therefore proposed to explain the accepted methods and the reasons for them as briefly as possible.

Before attempting to discuss the operation two facts must be made clear. Firstly, treatment must be varied according to the known habits of the type of tree, and secondly, no unnecessary work is ever justified, more especially at a stage where no remunerative return is obtainable.

The faulty treatment already referred to is the lopping off of the lower living branches of trees, this being done largely on the grounds that it will concentrate the vigour in the crown of the tree and more rapid growth will result. This, of course, is not necessarily the case, and a consideration of the functions of the leaves will readily explain the reason.

Leaves act as—

(*a*) Organs of transpiration; the roots in order to obtain sufficient salts from the earth for the manufacture of plant tissues absorb a relatively large quantity of water, and the surplus is transpired into the air by the leaves.

(*b*) Organs of respiration; they absorb carbon dioxide from the air and break this down into carbon and oxygen, the oxygen being released and the carbon retained. The energy required for this process is obtained from light which is absorbed by the chlorophyll in the leaves.

(*c*) Factories for the formation of plant food—this is done by the combination of carbon and salts in solution.

It will therefore be seen that leaves are essential for the life of the tree. In nature, living leaves are normally only discarded when there is insufficient light to enable them to

fulfil their functions, and it will therefore be seen that any pruning of living branches only reduces the capacity of the tree to form food for its continued growth.

Nevertheless, the forester aims at growing knot-free timber and his methods of growing the trees are designed to force the trees to prune themselves at a comparatively early age. He therefore attempts to obtain canopy, *i.e.*, a closing together of the crowns of the trees as soon as possible by planting at a close espacement.

Canopy serves several purposes. By shading the ground it kills weeds and reduces evaporation, and it later excludes light from the lowest branches, which consequently die and are discarded to form a soil enriching mulch.

The plantation thus has a comparatively clean floor and is much less liable to fire damage.

It is necessary here to mention the outer rows of trees, because these, owing to the fact that more light is available to them, maintain their lower branches. Such branches should not be pruned even if inferior timber should result, because they provide lateral canopy and considerably reduce all the harmful effects of wind.

To summarise it may be stated that avoidance of pruning living branches ensures:—

(*a*) Maximum efficiency of the leaf area of the tree.

(*b*) Formation of valuable canopy at an early age.

(*c*) Weed growth is eliminated naturally and rapidly.

(*d*) Evaporation is reduced to a minimum.

(*e*) Less liability of fungal diseases entering through open wounds.

(*f*) Less danger of fire damage.

As a general rule farm plantations which are established for the purpose of windbreaks, shelter belts and the production of fuel and poles, need no pruning. The object of pruning is to produce clean saw timber, and where the objects of a plantation do not envisage the production of saw timber for sale, pruning is simply a waste of time and money, and, in the case of windbreaks, of valuable protection.

The necessity and desirability of pruning may now be discussed.

Eucalypts.—The commoner eucalypts growing in this country prune themselves naturally and easily at a comparatively early age when established under proper plantation conditions. Artificial pruning is therefore usually unnecessary and need only be confined to trees with more than one leading shoot or having abnormally strong side branches. In both cases it might still be desirable to abstain from pruning if the treatment would cause large gaps in the canopy.

Conifers.—Unlike the eucalypts which when a branch is dead dispose of it very rapidly, many of the pines, cypresses, etc., retain their branches for a considerable number of years, and although this is natural to the type, foresters have realised in recent years that they cannot afford to await the completion of the process.

Under natural conditions, *i.e.*, in virgin forests, the conifers have been produced under conditions of great competition during possibly their first fifty years of life and the result has been that the side branches have died and in time been discarded. Subsequent growth over a long rotation has resulted in a large proportion of clean timber with only a narrow central core containing knots. This has been discarded or sold as low grade timber.

This method of producing timber is hardly practicable under present conditions in countries where afforestation is necessary to produce softwoods in a short time, so that it has become necessary to grow trees on short rotations, and to adopt artificial pruning in order to achieve knot-free timber.

It is neither necessary nor warranted on the score of expense to prune all trees in a plantation, and the operation is therefore confined usually to selected trees of the class which will form the final crop, after successive thinnings have been made.

This pruning is carried out sometimes to a height of twenty feet by various means, but is done in several stages. For example, the first six feet may be pruned, possibly when the trees are comparatively young, and two further prunings each of six feet or more may be carried out later.

Farmers are advised to consult the Division of Forestry before embarking on large scale pruning of conifers.

Other Species.—Some forest trees such as *Cedrela toona, Jacaranda mimosaefolia and Melia azederach*, although they produce valuable timber, generally produce branchy growth. The best method of pruning these is to rub off the buds before they become branches. This work should be carried out as high as the hand will reach, after which the trees will look after themselves.

If it is not possible to rub off the buds, the branches must be pruned. In performing both operations care must be taken to leave sufficient crowns on the trees so that there will be no serious check in growth.

General Notes on Pruning.—In all cases pruning must be carried out in such a manner as to leave no "snag" or projection of branch beyond the bole of the tree, for it is obvious that clean timber cannot result until the whole of the snag has been covered by new growth.

When the cut is made flush with the bole of the tree the scar is rapidly occluded by a stimulation of the surrounding cambial layer.

Pruning is most satisfactorily carried out by means of a pruning saw. The cut should be as vertical as possible, *i.e.*, parallel to the bole of the tree, and should be made in two stages, *viz.*, a small first cut upwards from the underside of the branch followed by the downward cut which finally severs the branch. If the first cut is made from above there will be a tendency for the weight of the branch to cause it to split and to tear the bark of the bole for some distance below its junction with the branch.

Except in the hands of an expert, pruning with axe, billhook or other pruning device is not advocated, because of the liability to leave a bigger snag than is desirable.

Arboriculture.—No mention has been made about the removal of large limbs and operations designed to improve the shape of specimen trees, as this is properly arboriculture and not forestry.

It will suffice to say that the same principles apply. Large scale removal of limbs should not be attempted at one time. Cuts should be made as near vertical as possible to prevent moisture seeping in to the wound, and when the cuts are large and unlikely to be occluded for many years, the surfaces should be painted over with tar or some other waterproof compound.

Summary of Recommendations.

1. In eucalypt plantations leave trees to prune themselves. Prune only the occasional double leaders and abnormally strong branches. Never prune outside trees.
2. In coniferous plantations prune dead branches only. Prune only trees likely to form the final crop.
3. With spreading trees such as the *Cedrela toona*, prune by removing lateral buds.
4. If pruning is necessary, prune flush with the bole of the tree, and leave no projecting snags.

Eelworm in Tobacco.

The following interesting letter has been received from Mr. A. D. Collins, of Waterfall Estate, Tsungwesi. We are particularly grateful to Mr. Collins for the trouble he has taken to supply us with the results of his careful observations and experiments.

"**General.**—It has again been noticed that land infested with nematode has failed to produce a maize crop. A twelve acre field partly infected was planted to maize following two years of tobacco following virgin veld. The part of the land not infected gave a normal yield of cobs and the infected part practically no yield at all. Up to the time of writing no maize roots have been found with the eelworm nodules, but I have no doubt that these could be found by a systematic search.

Tobacco Seed-beds.—A block of beds sufficient for forty acres were sown in mid-September and early October for planting out on the first rains. These seed-beds were situated on the Tsungwesi River and the water taken from the *centre* of a pool 5 feet in depth. Piers were built out into the pool. The rains broke late this season so that the plants had to be held back in the seed-beds and large ones discarded. No eelworm was found in the seed-beds from these sowings and on transplanting to the lands no eelworm developed in the land.

A second block of seed-beds were sown later on the same site (adjacent) and these were watered from the same pool before and *after* the rains broke. These developed eelworm in the beds and the beds were destroyed.

This again tends to bear out past observations, *i.e.*, that the risk of infestation is slight in the first seed-beds which are not watered from the river *after* the first flood waters come down.

The seed-bed sites chosen at the sites of springs not near any tobacco lands had no eelworm either in the seed-beds or when planted out in the lands. Complete freedom.

Field Observations.—A 7-acre field which had been slightly infested in the first year, badly infested in the second year, was again planted to tobacco with the object of seeing whether, by using a different system of land preparation, the field could be made capable of producing a fairly normal crop. A large number of plants were badly eaten down in a youngish stage by Koodoo and this affected the total yield, but the field produced 3,600 lbs. of cured leaf. Eelworm was present in the plants over the whole field, but did not attack the plants to any extent until after reaping had commenced. In other words, the plants grew out as far as size was concerned and the eelworm affected the body of the leaf, the leaf curing out a light bright. The leaf from this field has been sold and realised an average of 13.73d. per lb.

Throughout 230 acres of tobacco, of which 99 acres were second year land, very little eelworm was found on the second year land (present in 1936/37 crop) and *none whatever* on first year land. This is put down to the seed-bed arrangements previously explained, and it is hoped, to the new cultural methods. As far as the latter is concerned, it is not entirely new in this Colony, but it has been approached from the point of view of eradication of eelworm and is considered by myself and those working here to be a possible solution to the eelworm menace and well worthy of experiment by the officers of the Experimental Station at Trelawney.

I will now explain this method and put forward what I consider may be arguments in favour and reasons for trying out the scheme.

Firstly, the life and habits of the eelworm were kept in mind.

(1) That they died at a temperature of 105° and over.

(2) That their rate of progress in the soil is exceedingly slow.

(3) That they are usually distributed over the lands by flood water.

(4) That if the plant is attacked at an early stage it hardly ever grows to more than 18 inches, but if at a late stage then a crop of bright leaf will be obtained.

So these facts were taken together in formulating a programme and the following procedure adopted.

Firstly, the land (second year) was ploughed to 9 inches depth and all second year land was ploughed prior to November 1st.

It was assumed that the heat of the sun would kill any eelworm to a depth of 2 inches.

Fertilising was carried out after harrowing of the individual blocks had been completed. The ordinary check-row chain was used and the fertiliser boys placed the fertiliser round each "knot" of the chain. These boys were followed by a gang with hoes who built up a "hill" or mound over each lot of fertiliser. These hills were not mere scratches but a substantial hill with a base of approximately 1 ft. 6 ins.

When the field was completed it was ready for planting. In theory these hills were made in order to comply with the four basic facts previously mentioned.

The soil forming the hills was taken from the surface soil surrounding the fertiliser so that the hill was founded on 9 inches of ploughed soil, of which 2 inches was reckoned as being free from eelworm. The soil brought to form the hill was most likely also free from eelworm, but if any boy struck his hoe deeply the soil so disturbed would be on the outer side of the hill. The hills were then composed of eelworm free soil (?) and had maximum humus content. If the hills were to become infected with eelworm it could only be by the eelworm travelling up from below (which it would *not* do prior to the rains as it would run the risk of being killed by the sun) or by wash soil in the rains. The hills overcome to a very great extent the risk of infection between hills by rain water, as they stand above the rain water and if the eelworm gets into the water stream between the hills it would have to work its way into the hill either from the side or from below.

With the coming of the rains the tobacco was planted out and in a few days became established. It was therefore growing well before the eelworm could attack it. It had six inches of surface soil before it reached the fertiliser and a further depth of nine inches of ploughed soil below in which to develop an extensive root system.

It is considered that hills properly made isolate each plant so that the risk of infection from plant to plant is reduced to a minimum and surplus rain water is carried off between hills and the eelworm goes with it. If eelworm plants are inadvertantly planted out then they are at least less dangerous to their neighbours than when planted on the flat or in the ridge. An infected plant from seed-beds will only destroy itself. A clean plant infected in a hill will grow in the initial stages strongly enough to produce a payable crop. Where no eelworm is present the crop will derive benefit from the extra fine tilth of the soil, the better weeding, and in a wet season will not suffer from wet feet.

A severe drought has been experienced this year and plants on hills do not appear to be any worse off than those planted on the ridge.

The opinions expressed here are not intended to be scientific nor even correct, but only the thoughts and efforts of a practical grower to solve a most difficult problem, and if the scientists will now work up these ideas I think some good may accrue. In any case, the tilth on the soil and the individual attention each plant receives automatically produces a better crop.

Maybe a chemical mixed with the fertiliser may help.

If there are any points which I have not made clear I will endeavour to do so. In conclusion, I must say that I consider this the greatest advance made on this Estate after eight years of various experiments in crop rotations, ploughing, etc."

Common Diseases of Apples
AND THEIR CONTROL IN SOUTHERN RHODESIA.

By J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., and Aline L. Bacon, B.Sc., Division of Plant Pathology.

In the issue of this Journal for August, 1937(1) a general description was given of the known diseases of apples occurring in Southern Rhodesia, and recommendations for control were made based on the information available at that time.

During the past year considerable progress has been made in the investigation of apple diseases under local conditions, and satisfactory results have been obtained from preliminary spraying trials. It seems desirable, therefore, that the wider information obtained should be made known and an improved spray schedule recommended for use.

General Considerations.—Observations in field and storage made during the past year show that

(1) The full significance of the microscopic fungus as the occasioner of disease does not appear to be grasped by the majority of apple growers.

(2) Nearly all apple orchards carry a considerable amount of dead wood.

(3) Very little attempt is being made to control diseases either by pruning or spraying.

(4) Mildew infection is high in all orchards below 5,000 ft. altitude, and in numerous cases paves the way for infection by die-back fungi.

(5) Marketed fruit contains an abnormally high percentage of breakdown due to rots resulting from infection contracted in the orchard.

(6) Where spraying schedules are followed and orchard sanitation practised, little trouble is experienced with the more common parasitic diseases.

To sum up, it may be said that early planted trees are in most instances badly affected by such diseases as black rot, canker or die-back and are in need of immediate treatment. New plantings are relatively clean, but many show a dangerous amount of mildew. Where plant protection measures have been put into efficient operation, however, considerable improvement in trees can be seen within a short period, and this improvement is reflected in a reduction of fruit rots.

It will therefore be to the benefit of the rapidly growing apple industry if efforts be made immediately to eradicate diseases from the old orchards and employ every reasonable method to protect the new plantings.

Descriptions of Diseases.

The more common diseases will now be described in detail and recommendations for their control made at the conclusion of this article.

BITTER ROT (*Glomerella cingulata* (Stonem) S. & v. S.).

On Branches.—This fungus causes irregular cankers to form, but appears to be rare on branches in this Colony. It has been recorded once following locust injury .

On Fruits.—The first sign of bitter rot on fruits is a small, light brown sunken spot which rapidly increases in diameter and may appear zoned. (Pl. II., Fig. 7.) Shortly after the rot commences, small black blisters appear in the centre of the diseased area, spread outwards and are frequently arranged in concentric circles. The blisters increase in size, causing the skin to rupture, and pink, moist looking pustules of spores are exposed (Pl. II., Fig. 5).

The disease may be present in the orchard or may only develop in storage. Infected orchard apples fall early or become "mummified" on the trees, the "mummies" being a source of infection to healthy fruit.

BLACK ROT (*Haplosporella Mali* (West.) Pet. & Syd.).

On Branches.—This fungus, which is a wound parasite, causes a series die-back and canker on branches of apple trees. The chief place of entry appears to be untreated pruning wounds (Pl. I., Fig. 4) or other mechanical injuries. It may also penetrate through small areas of bark killed by mildew.

As the name of the disease implies, twigs and branches develop a characteritic black colouration.

The bark becomes roughened into minute blisters by the fruiting bodies (pycnidia) which develop underneath it. It eventually ruptures and the black pycnidia, containing the spores which carry the disease to healthy trees, can be seen in the cracks, or the "skin" may peel off leaving the pycnidia exposed. The bark in the diseased area is discoloured from reddish brown to black, and as the disease advances, the bark may split, the cracks so formed encircling the stem, the edges curling up to show the wood underneath.

Very young infected branches do not appear to crack and peel to the same extent as older branches, but the many scattered fruiting bodies show up very clearly.

On Fruits.—Fruits affected by black rot show first of all small circular brown areas, which rapidly increase in size, and soon a firm, spongy rot affects the whole fruit, as distinct from the soft pulpiness of bitter rot. It eventually becomes black and shrivels up, remaining on the tree in the condition known as "mummied."

A few specimens of fruit affected by *Haplosporella Mali* have been observed usually following hail or other damage, but the disease does not appear to be as serious as bitter rot.

Wounded and unwounded apples were inoculated with the fungus which had been isolated from a diseased twig. The wounded apple developed a firm black rot, the skin being covered with thousands of small black pycnidia similar to those found on the branches. No rot developed in the unwounded apple.

DIE-BACK AND CANKER (*Botryosphaeria Ribis chromogena* Shear, Stevens and Wilcox).

On Branches.—The first evidence of this disease on branches is the presence of many small raised blisters underneath the bark. These cause the bark to rupture and jagged cracks are formed in which the black fruiting bodies (pycnidia and perithecia) can be seen. It is in these that the spores which spread the disease to healthy trees, are formed.

The skin may flake off exposing rusty-looking, dark brown areas and the wood beneath this is discoloured due to gumming, which can easily be seen when the wood is cut.

The fungus was first isolated from a dying apple tree, the trunk of which showed symptoms of attack. It appeared to have gained entry through a split in the crotch.

On Fruits.—Apple fruits were inoculated with the fungus from the above mentioned isolation, one apple being wounded and the other sound. Disease developed very rapidly in the wounded fruit, starting as a light brown rot round the point of inoculation, which spread and darkened in colour. After a few days, small black spots (the fruiting bodies) were observed in the more advanced rotted area, and these spread rapidly until the entire apple was covered with black fruiting bodies. Drops of liquid oozed through the skin and remained in globules on the surface. Later, tufts of grey green mycelium grew through the skin. (Pl. II., Fig. 8).

The sound apple did not rot for some time, but eventually it developed the same symptoms as the wounded.

Numbers of apples with this unpleasant wet rot, exhibiting the symptoms observed in the inoculation experiments, have been seen in storage this season. As infection is carried to neighbouring fruits in the liquid that is liberated, it will readily be understood that one infected apple may cause an entire box to become unsaleable if stored for any but a short period of time.

Infected apples usually appear to have been punctured by insects or damaged in some other way, and it is through these wounds that the fungus gains entrance. However, inoculation experiments suggest that unwounded apples also may be affected.

One small shrivelled apple on which fruiting bodies were found, was collected in an orchard this season.

DIE-BACKS (*Valsa leucostoma* (Pers.) Sacc. and *Phomopsis Mali* Roberts).

Die-back caused by the fungus, *Valsa leucostoma*, probably enters through pruning wounds and other mechanical injuries. The leaves on the diseased limb wither, and

gumming takes place between the healthy and diseased portions of the branch. Later tiny fruiting bodies appear pushing up through the dead bark. When mature, they can be distinguished from those of other previously described fungi, by the presence of a minute white spot in the centre of each.

The die-back caused by *Phomospsis Mali* closely resembles that due to black rot and may be controlled by the methods advocated for that disease (Pl. I., Fig. 3).

BRANCH BLISTER, FRUIT CRACKING OR ROUGH SCAB (*Coniothecium chomatosporum* Cda.)

On Branches.—This disease is common on one or two-year-old laterals, but is usually complicated by secondary infection on older branches, so that the blister symptoms are not recognisable.

It appears in the form of small, light brown blisters, arranged singly or in groups. They may coalesce to form larger blisters, which later split and form irregularly shaped cankers. The characteristic symptoms are frequently found on branches of the "Delicious" variety.

On Fruits.—Fruits affected by *Coniothecium chomatosporum* are very characteristic in appearance. Those infected early develop large, unsightly cracks (Pl. II., Fig. 6), on the sides of which a dark grey-green growth may develop. This growth may be the fructifications of the fungus, but is frequently found to be another fungus (*Alternaria* sp.) which establishes itself in the cracks and causes the fruit to rot.

Apples infected later in the season have a scabby, russetted appearance, the infection usually being heaviest round the stalk. Ohinemuri variety is particularly susceptible.

MILDEW (*Podosphaera leucotricha* (Ell. and Ev.) Salm.).

This disease is particularly widespread and severe in Southern Rhodesia, especially at altitudes below 5,000 ft. Of the popular varieties grown Rome Beauty is especially susceptible, but the following are also seriously attacked, Cleopatra, Greening, Reinette du Canada, Wine Sap and Lord Wolseley.

A full description of this disease was published in this *Journal* last August(1), but it appears to be of such importance to the apple industry that no excuse is made for repeating its life history.

". . . . . the Mildew fungus grows over the bark of new wood, covering it with a white felt, which consists of a densely woven mat of very fine threads. From these threads, tubes are forced into the surface cells of the apple twig, by means of which the fungus withdraws nutriment for its sustenance, at the same time killing the cells. Fortunately the fungus does not penetrate more deeply into the tissues of its host, and is therefore vulnerable to attack from outside the plant. However, some strands of the fungal mat, which grows over the shoots, penetrate beneath the scales surrounding the young buds and remain dormant during the winter months, only becoming active when bud movement begins in spring. The fungal strands commence to grow over the newly-formed leaves as they emerge from the opening buds, starting the disease up again. The fungus then continues to grow over the surface of the infected leaves, and soon produces millions of spores which give to the diseased areas the well-known powdery appearance characteristic of this type of mildew. These spores are scattered by wind and rain, and when they alight on a new leaf and conditions are favourable, they germinate and send out strands to form a fresh fungal mat, which grows down the leaf stalks on to the new shoots. If not removed, it remains dormant during the winter, only to initiate a fresh outbreak in the following spring."

The disease attacks leaves, shoots and fruits. Its characteristic powdery appearance on upward curled leaves is impossible to overlook, but its occurrence on newly expanded buds and new shoots is not always observed by growers. Illustrations of the former were published in the article referred to above(1) whilst new shoots killed by mildew are now shown in Pl. I., Fig. 1. The death of these new shoots not only retards the growth of trees, particularly young trees, but also affords entry to the various die-back fungi.

Experiments carried out this year have shown that mildew may be controlled by suitable methods of spraying and sanita-

tion, which will be described later. Eradication from the nursery is particularly desirable.

SOOTY BLOTCH (*Gloeodes pomigena* (Schw.) Colby).

On Fruit.—The sooty blotch fungus is purely superficial, and does no actual damage to the flesh. However, it causes black blotches on the skin which resemble a powdering of soot. These sooty blotches spoil the appearance of the fruit, thus lowering its market value.

*Chloride of lime treatment should be used to remove the spots, but it is generally controlled by the usual spray programme.

SOFT BROWN ROT (*Alternaria* spp.).

On Fruits.—There is more than one *Alternaria* which causes rots in apples, but as they are symptomatically similar they may be dealt with together.

Alternaria has already been mentioned as being secondary to the fruit cracking fungus (*Coniothecium chomatosporum*). It may follow any injury caused by such agencies as hail, insect or sun scorch in the orchard, and has been found on several occasions following Bitter pit.

Injured and uninjured apples have been inoculated with the fungus, which has been shown to be a wound parasite only.

The rot starts as a brown spot, soft to the touch, which increases in size fairly rapidly. If the rotting apples are kept for some time in storage, the fungus which is of a dark, dirty green colour, grows out to the surface, appearing as a mouldy coating on the skin.

STORAGE MOULDS.

There are a number of variously coloured moulds which cause apples to rot in storage, and several may be present in one fruit. *Aspergillus niger*, and *Rhizopus nigricans* with their black fructifications, and *Penicillium* with its green, are among the fruit rotting moulds found in Southern Rhodesia.

*Dip the fruit for one minute in the clean solution decanted from a 5 per cent. suspension of bleaching powder in water. Expose to the air for 1 hour, or until bleached, wash in water and dry.

MOULDY CORE.

Apples which outwardly appear to be quite sound, may, on cutting, be found to have various moulds growing in the core, causing the surrounding tissues to rot. Varieties such as York Imperial, with open calyxes through which the spores of these moulds enter, are most susceptible.

BITTER PIT (Non-pasasitic).

This disease is of common occurrence on most varieties, although Versfeld's, Blenheim Orange and Cox's Orange appear to be particularly susceptible, the fruit often being affected whilst still on the trees.

The symptoms, which are generally known to most growers, usually appear after the apples have been kept for a short time in storage. Small black depressed spots appear on the skin and may enlarge to about a quarter of an inch in diameter. If numerous, they may coalesce to form black, irregular depressions.

If these spots are cut into with a knife, a brown corky area will be found in the flesh directly beneath them. If the fruit is further cut into, small, often mere pinpoints, of brown corky tissue will be found to be scattered through the flesh. Fruit affected in this way has a characteristic faintly bitter taste, which has given the name of Bitter pit to the disease.

The trouble is due to an insufficient supply of water for those parts of the fruit which are ripening.

The cells of the immature fruit are packed with starch and ripening consists roughly of the conversion of this starch to sugar, during which process water is required. If, for some reason, this water cannot be supplied by the tree, then the ripening cells draw water from the tissues surrounding them until a stage is reached where the last cells to give up water are unable to obtain any more. Under these circumstances they die and a corky layer is formed round them as a natural wound reaction on the part of the plant. The small corky spots form the characteristic symptoms of the disease.

General recommendations for the control of bitter pit in Rhodesia cannot as yet be made. It is known that trees become less susceptible as they grow older, and also that picking of immature fruit favours the development of the disease in storage, but exact data regarding optimum time of picking of each variety can only be obtained by careful experimentation under the widely varying conditions of local culture.

WATER CORE (Non-parasitic).

This disease is also of common occurrence and well known. It is particularly severe on the Ohinemuri (Dunn's seedling) variety.

The core and flesh of affected fruits take on a water-soaked or glassy appearance which makes them unfit for marketing. Watercore apples do not keep well in storage and should be excluded from export consignments.

The exact nature of the disease is not yet fully understood, but recent work has shown that the trouble is associated with periods of depressed transpiration in the plant, high fruit temperatures on the trees, light cropping and large fruit.

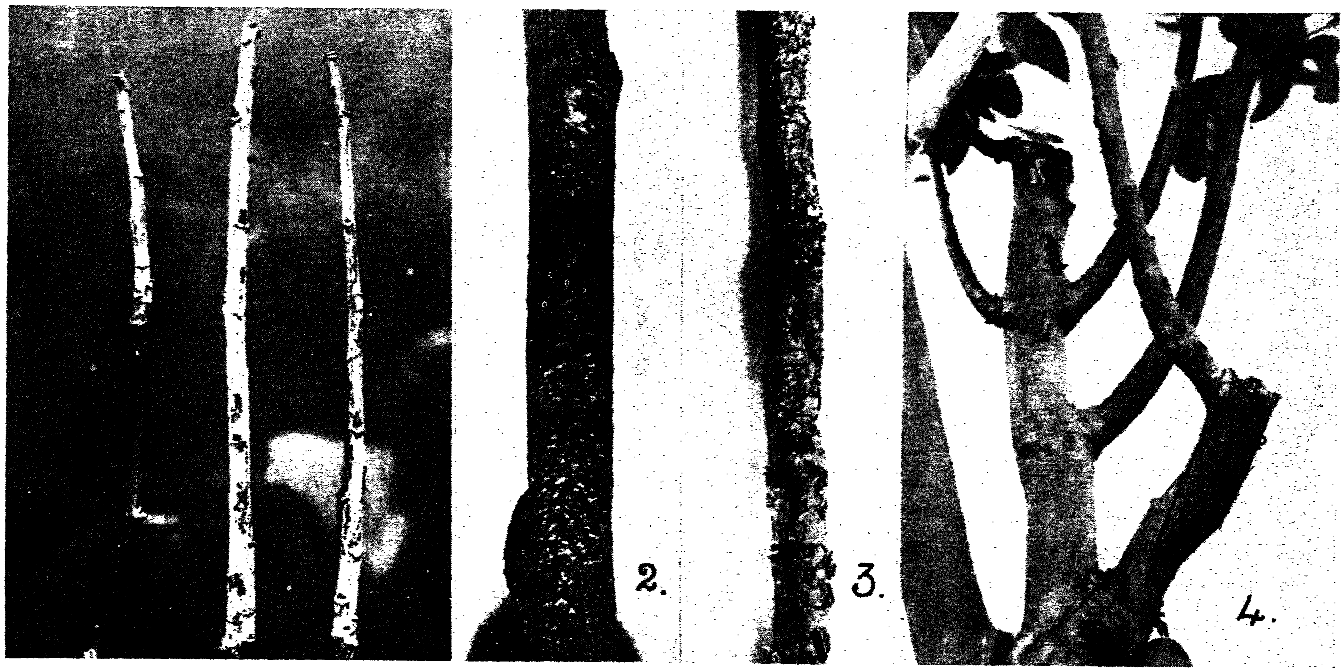
Satisfactory control measures are not known, but excessive thinning of trees in order to produce large fruit of susceptible varieties should be avoided.

MEASLES (Cause uncertain).

A disease, which has some of the characteristics of blister disease, but is also associated with several other fungi, including the common die-back organism *Phomopsis Mali,* is invariably found affecting Jonathan and White Winter Pearmain varieties (Pl. I., Fig. 2). It is apparently the same as that known in the Union as "measles" and attributed to unfavourable soil conditions.

The disease is being studied in the Plant Pathology laboratory and it is suspected that a specific fungus may be involved.

Further experimentation is required before recommendations for control can be made.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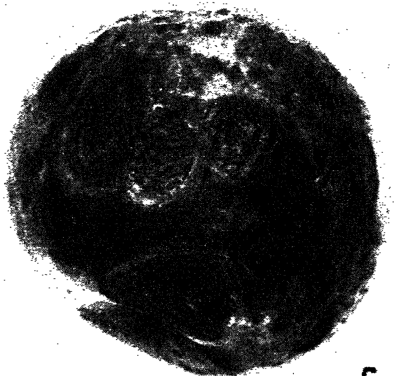

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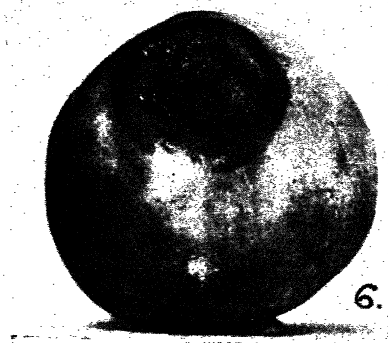

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Control Measures.

These are divided into three classes, namely, (1) elimination of sources of infection or orchard sanitation, (2) protective spraying, and (3) in the case of mildew only, curative spraying.

(1) **Orchard Sanitation.**—It has been remarked earlier in this article that nearly all orchards carry a large amount of dead wood. These branches are only dead as far as future growth is concerned, but are very actively alive in spreading disease from limb to limb and from limb to fruit. What appears to be merely a dead twig or shoot is in a reality a teeming mass of fungus growth, which if left unchecked will eventually kill the whole tree as well as its neighbours. If apple growing is to be made into a profitable proposition, and especially if an export market is visualised, *every piece of dead wood must be removed from every tree every year.*

In cutting out diseased wood it is necessary to be ruthless. Not only the obviously dead branches must be removed, but it is necessary to cut at least three inches into green wood below the last visible point of discolouration. If the discoloured wood extends from a small lateral into a larger limb, then the large limb must be cut back. If the infection extends far down the large limb to near the crotch of the trunk (as is the case in very many orchards), then it may be necessary to remove all the branches and top work the tree again. The essential point to remember is that the die-back fungus penetrates beyond the visibly infected wood, and if not removed will continue to advance and cause further die-back, eventually killing the tree.

It will be found that a very small island of discolouration may extend down the heart wood well in advance of the actual die-back, and it is because growers allow this diseased fragment to remain that die-back progresses despite the efforts made to eliminate it.

Furthermore, it is very necessary to protect all wounds, particularly pruning cuts, with a disinfectant, and for this

purpose carbolineum should be used. The treated wound should later be given a coat of stockholm tar as a permanent protection. These precautions are found to be imperative under general Rhodesian conditions, where die-back and canker-forming fungi appear to be far more persistent and aggressive than in more temperate countries.

On many trees, cankers can be seen to be forming round wounds caused by cultivating implements, oxen, etc. These cankers should be cut out, well back into the green wood, and treated with carbolineum and stockholm tar. It is, however, a much safer policy to treat wounds immediately they are made and thus prevent parasitic fungi from gaining entry to the tree. This is specially important when the trunk of a tree is injured.

In addition to cutting out the dead wood, all "mummy" or withered fruit attached to the trees should be collected, as these are also sources of infection for both fruits and branches.

This work should be carried out in the dormant season (June or July), and all debris must be brought together and burnt as soon as possible. The destruction of all this rubbish is of the utmost importance, for if allowed to remain in the orchards, the disease-producing fungi which it contains will liberate millions upon millions of microscopic spores which will start the troubles all over again.

(2) **Spraying.**—As explained in a previous article(1) in this Journal, for spraying to be an economic proposition, a schedule must be devised for the simultaneous control of mildew, die-backs, fruit rots and insect pests. This involves a series of applications of combined fungicides and insecticides aimed at attacking the parasites in the most vulnerable parts of their life histories.

Until further experimental results have been obtained, the following spray schedule is recommended for use under Rhodesian conditions. The full spray programme is certainly

necessary where apples are grown below 5,000 ft., but it seems likely that some modifications may be made later for the cooler districts.

Spraying must be carried out precisely at the correct times, which are fixed according to the stage of development of the fruit buds. In the past much difficulty has arisen regarding the time of application of sprays owing to the irregularity of blossoming which occurs in Rhodesia. It has been found, however, that the use of miscible oil in the winter spray fluid not only controls scale insects and mites, but also induces accelerated and much more uniform blossoming.

General experience indicates that one application of oil during the dormant period is sufficient for the season. This, however, is not the case with fungicidal sprays, which it is necessary to apply according to the following table:—

SPRAY SCHEDULE.

Time.	Concentrated Spray Ingredients per 100 Gallons.	Control of
Dormant ...	Lime sulphur 7 gall. + miscible oil 4 gall.	Mildew, scab, branch blister, canker, scale, mites.
Green Tip ...	Lime sulphur 2 gall. + colloidal sulphur 2 lb.	Fruit cracking, branch blister and scab.
Pink	Lime sulphur 1 gall. + colloidal sulphur 2 lb. + lead arsenate (basic) 2 lb.	Mildew, cracking, scab and beetles.*
Petal Fall ...	Lime sulphur ½ gall. + colloidal sulphur 2 lb. + lead arsenate 2 lb.	ditto.
Two weeks later	Lime sulphur ½ gall. + colloidal sulphur 2 lb.	Mildew and scab.
Fruit half ripe	Bordeaux mixture 8 lb. + lethalate spreader 6 oz.	Bitter rot.

*It has been found in practice that lead arsenate applied at this time helps to control blossom eating beetles. No exact information on this point has as yet been obtained, but the Division of Entomology recommends the use of this insecticide on empirical grounds.

The stage of bud development on which this schedule is founded may be described as follows:—

TIMES FOR SPRAYING.

Dormant ...	When leaves have fallen and before buds begin to swell, approximately between mid-June and early August.
Green tip ...	When the green tips of the leaves first protrude from the buds.
Pink	When the fruit buds are showing pink but before the petals unfold.
Petal Fall ...	When the majority of blossoms have fallen, but whilst some remain on the trees.

Proprietary brands of lime sulphur (39% polysulphide content), are sold in Rhodesia and can be obtained through most horticultural stores. Two brands of colloidal sulphur are marketed under the names of "Capoidal Insecticide" and "Sulsol." Bordeaux may be obtained as a ready mixed powder ("Dry Bordeaux") or done up in separate packets of copper sulphate and hydrated lime ("Ky-Bordeaux"), the latter being a much superior product, more suitable for fruit tree spraying. Only one brand of miscible oil is sold locally, as far as is known, and this is called "Pestridol." The spreader recommended is "Lethalate Wetting Preparation," but other spreaders are also stocked by most firms.

The concentrations of spray fluids recommended in the schedule have been tested on the following varieties without causing appreciable injury:—

Rome Beauty, Versfeld's, Ohinemuri (Dunn's seedling), Jonathan, Delicious. Ohinemuri variety is somewhat sulphur-sensitive and slight scorching of the edges of some leaves occurred, but no damage to fruit was observed. It must be emphasised, however, that deviations from the concentrations recommended may result in severe scorching of leaves and russetting of fruit.

To growers unacquainted with commercial fruit growing in other countries, the above spray programme may be somewhat in the nature of bombshell, but if a profitable industry is to be established, fruit must be marketed free from disease

infection so that it will keep in good condition for several months. Storage rots are intimately connected with orchard conditions, and in most cases are a direct result of infection contracted before picking, and it is most important for growers to appreciate fully this relationship. Only by adopting a programme which is designed to control all the important diseases and pests can growers hope to grow fruit in quantity at a profit.

Another matter of importance is the spraying equipment. It is generally accepted to-day in apple growing countries that pressures of 300-400 lb. to the square inch are necessary for efficient control of all diseases and pests. Such a pressure, of course, can only be obtained from a power sprayer, and growers who contemplate planting trees by the thousand will in a few years time be faced with the necessity of purchasing such equipment. For the small orchardist with a few dozen young trees, a pump giving a pressure of 90 to 150 lb. per square inch will suffice, provided it is fitted with 20 to 30 ft. of $\frac{3}{8}$ inch hose, extension tube (lance) and nozzle of the usual whorl type giving a fine spray. It should be noted that the so-called "Bordeaux" nozzle consisting of a tapered jet in an adjustable tap, is unsuitable for fruit tree spraying. It was patented in 1878 and has undergone little modification since. It is wasteful and produces a coarse spray with poor covering properties.

Numerous types of pump are in existence, but none really suitable for orchard work is stocked in Rhodesia. Growers wishing to replace their old equipment should consult the Division of Plant Pathology before placing their orders.

As a final word of admonition it will not be out of place to emphasise the utmost importance of **thoroughness** in disease control operations. Particular attention must be paid to detail, and instructions followed to the letter if satisfactory results are to be obtained.

SUMMARY.

1. An account is given of investigations which have been made into apple diseases during the past year.

2. The more common diseases encountered in most orchards in Rhodesia are described.

3. Recommendations are made for the control of these diseases by a new spray schedule and other means.

4. Advice is offered regarding spray equipment.

REFERENCES.

(1)Hopkins, J. C. F.: "A Programme for the Control of Diseases of Apples in Southern Rhodesia." *Rhod. Agric. Journ.*, xxxiv., 8, 1937.

EXPLANATION OF PLATES.

Plate I.

1. New apple shoots killed by mildew.
2. "Measles" on Jonathan variety, second year wood.
3. Die-back and rough bark of White Winter Pearmain caused by *Phomopsis Mali* followed by the fungus *Fracchiaea heterogena*.
4. Black rot developing from pruning wound. If unchecked, the disease will penetrate to the trunk and kill the tree.

Plate II.

5. Advanced bitter rot, showing pustules of spores.
6. Fruit cracking of Rome Beauty variety caused by the fungus *Coniothecium chomatosporum*.
7. Bitter rot four days after first visible signs of disease.
8. Wet rot of fruit due to the canker fungus. Note the drops of moisture oozing through the skin.

Annual Report of the Branch of Chemistry

FOR THE YEAR ENDED 31ST DECEMBER, 1937.

By A. D. HUSBAND, F.I.C., Chief Chemist.

The chief activity of the Chemistry Branch is the accomplishment of the routine analytical work coming within the sphere of the agricultural chemist.

A certain amount of work is also carried out on behalf of other Departments of the Civil Service, private firms, and individuals, but during the year under review the demand for services by other Departments has been somewhat less than usual. On the other hand, a very considerable call for chemical services has been made by other branches of the Agricultural Department in connection with problems in which they are interested, or research in which they are engaged.

The amount of pure research carried out on soil problems is naturally limited owing to the necessity of dealing expeditiously with ordinary routine analytical work, but certain problems have nevertheless been investigated and useful information obtained.

A number of new projects have recently been embarked upon designed to elucidate the action of green-manuring on the soil structure, base exchange, and soil fertility.

In addition, the nitrification experiments commenced two years ago have been continued and useful practical information has been obtained.

Summary of Routine Samples.—The following is a summarised list of the routine samples analysed, examined, or otherwise investigated:—

Soils	275
Manures and Fertilisers	50
Farm Foods	65
Toxicological...	149
Waters	21
Limes and Limestones	10
Vegetable Products	233
Dairy Products	15
Tobacco Seed Samples...	151
Miscellaneous	57
	1,026

In addition, 70 litres of standard caustic soda were prepared and issued to the Chief Dairy Officer for distribution to dairy farmers, and 230 litres of standard iodine solution were prepared for the Veterinary Department for use of Cattle Inspectors.

Soils.—The soil samples for the year included 118 for analysis and advice as to suitability for production of tobacco, all for the flue-cured type, except four, which were for fire-cured leaf. Nine represented soils from seed-beds on three different farms where the tobacco seedlings either failed to grow or died off at an early stage. All these samples contained excessive amounts of alkaline soluble salts, and it was considered that the failure of the seedlings was due partly to excessive wood-ash and partly to watering with strongly alkaline waters. A note in connection with this appeared in the *Rhodesia Agricultural Journal* for January, 1938.

Ninety-seven of the remaining soil samples were for advice as to general cropping. Fourteen were submitted by the Agriculturist from the newly-formed pasture experiment plots at Rusapi, with a view to a comparison in the future with further samples to be submitted from the same plots after treatment, in an endeavour to trace the effects of the treatments given.

A preliminary soil survey of types of soil commanded under the proposed irrigation scheme in the Maranka Reserve was carried out by Mr. Ellis, Assistant Chemist, during April, 1937, and his report, embodying the results of analyses of 18 samples, was forwarded to the Director of Irrigation in July.

The survey was very rapid and only a portion of the total area was examined. In spite of the hilliness of the country, the central portion of the proposed scheme was regarded as suitable for irrigation. In the other parts, the soil was thought to be too poor or too shallow. It was considered that the mopani veld developing on the well drained soils of this area was not likely to become a menace, but on the other hand, was likely to benefit from irrigation. Some generalised conclusions were made with regard to treatment of the soils in the event of the adoption of the scheme.

In continuation of the soil conservation work going on at Glenara by the Irrigation Division, mentioned in the Report for 1936, eight further samples of eroded soil from the traps and tanks were subjected to chemical and physical analyses.

Similar work by the Irrigation Division is now being done at Ingutsheni, near Bulawayo, and 11 samples were submitted and analysed in connection with the erosion run-off experiment there. Five were samples of surface soil from the areas between the contour ridges, two were samples of rubble and decomposing rock from below the surface, and four were samples of silts from the traps and tanks.

Manures and Fertilisers.—Thirty-seven fertiliser samples have been analysed under the "Fertilisers, Farm Foods, Seeds and Pest Remedies Ordinance," and three of them were found to be slightly below the limit allowed on their registered guarantees. The firms concerned were duly notified, and warned that prosecution would immediately follow further infringements.

The remaining manure samples call for no special comment, and comprise composts, bat guanos, leaf moulds, etc.

Farm Foods.—Eight of these samples were analysed under the Ordinance, all conforming to guarantee, and 10 were meat meals, carcase meals, and bone meals from the Rhodesian Export & Cold Storage Company, Limited, Bulawayo, for fat and protein contents; the iodine values of 26 different food products were ascertained for the Chief Animal Husbandry Officer, and the remainder of the samples were miscellaneous types of farm foods, investigated for private individuals and commercial firms.

Toxicological Analyses.—Included here are six dip samples analysed to ascertain arsenical strength at the request of veterinary officials. Except for three waters which were tested for cyanide, one with positive result, and two negative, and one water which gave a positive test for saponin, the remaining 139 were pathological specimens from dead animals, waters, or soils, to be tested for arsenic. Included among them are 10 samples in connection with the investigation still proceeding in the Umtali area on the alleged chronic arsenical poisoning of cattle by arsenic emanating from mine dumps. Of the further 129, 56 were found to contain arsenic in appreciable quantity, while 73 showed no trace of it, or only a negligible amount. It is gratifying to note that the cases of deaths of animals definitely ascertained by analysis to be due to arsenical poisoning amount only to about one-third of those which were reported by us for the year 1936.

Waters.—These were unimportant, being submitted for estimation of hardness and for opinion as to whether they were suited for use in boilers or for irrigation purposes. Four were analysed in connection with the seed-bed difficulties referred to under soil samples.

Limes and Limestones.—These consisted of calcareous rocks, travertines, and lime nodules for estimation of value as agricultural lime, and are not of special interest.

Vegetable Products.—In an endeavour to identify the weed or weeds which cause disagreeable odours and tastes in butter and milk, the essential oils of 20 different weeds were isolated in the laboratory by steam distillation, and sent to the Chief Dairy Officer, who has the subject under investigation.

Four samples of different geranium leaves have also been subjected to essential oil extraction with a view to discovering the most favourable type, and the most favourable stage of growth to procure an oil suitable for commercial purposes. Unfortunately, to date, with the exception of one sample, *Pelargonium radula*, ex Kirstenbosch, which has produced a fairly satisfactory type of oil, neither the quantity nor the quality of the oil extracted in the other samples proved of the desired standard; the quantity varied roughly from .02

to .20%, but the odour in all was of lemon flavour, and did not contain the rose aroma demanded by the trade. Trials are proceeding and further extractions will be made in the coming year.

A complete oil extraction from 50 lbs. of Avocado pears was made on behalf of the Alternative Crops Committee. The total oil extracted was 2,160 c.c.'s, representing by weight 12.6% of the fresh material; this compares favourably with percentages obtained in California by commercial methods, where the average percentage from 40 samples was 14.

The carbon-nitrogen ratios of 39 samples of different sorghums cut at weekly intervals were estimated for the Agriculturist. Sorghums are recommended as a trap-crop against witchweed, and the object of the work was to ascertain the optimum stage to plough these under from the point of view of influencing favourably the carbon-nitrogen ratio of the soil after their function as trap-crop was completed.

The moisture and protein contents of 112 wheat varieties were ascertained for the Plant Breeder, Hillside Experiment Station.

Analyses were made of eight different types of roots of indigenous shrubs eaten by natives in times of food shortage. These were done at the request of the Chief Native Commissioner, who requested information as to their feeding value.

The remaining vegetable products handled throughout the year consisted of grasses, silage, tobacco leaf, sugar-cane, various grains, etc.

Dairy Products.—The 15 samples enumerated here consisted of milk, cream, butter, curds, all analysed for normality or otherwise, and none is of special interest.

Tobacco Seed Samples.—The amount of tobacco seed subjected to treatment during 1937 was over 50% greater than in the preceding year. Altogether 4,284 ozs. of seed were cleaned, treated, or subjected to both cleaning and treating, as compared with 2,690 ozs. for 1936. An extra lady assistant was employed exclusively on this work for a period of almost two months.

Miscellaneous.—Thirty-five of the samples under this heading consisted of bacon fats for iodine value estimation. These were submitted by the Chief Animal Husbandry Officer in connection with an investigation into the feeding of pigs in the country.

The remaining 22 included such varied materials as wood preservatives, orange peel, barks, soap, red oxide, oil for volatility and viscosity tests, thermometers for standarisation, etc.

Investigational Work.—(1) *Nitrification Experiments.*—These investigations—a comparison of the nitrifying capacities of local soil on blood meal and sulphate of ammonia as media—which were reported upon at the end of 1936 as having been inconclusive for that year, were again undertaken throughout 1937 and were continued for a period of six months commencing November, 1936. The technique has already been described in the Annual Report for 1935.

The results obtained were strictly comparable with those for 1935, and leave no room for doubt that for the first three months of the growing season blood meal is much more quickly nitrified than sulphate of ammonia, but that eventually more nitric nitrogen is obtained from the sulphate of ammonia.

The results were as follows:—

	1937. Nitric Nitrogen recovered. %		1935. Nitric Nitrogen recovered. %	
	Blood meal.	Sulphate of Ammonia.	Blood meal.	Sulphate of Ammonia.
After 1 month ...	44.0	22.5	20.7	11.3
After 2 months ...	49.7	39.6	51.1	31.4
After 3 months ...	57.2	56.0	54.5	62.5
After 4 months ...	35.8	75.2		
After 5 months ...	24.8	71.0		
After 6 months ...	13.7	29.8		

The diminution in nitric nitrogen percentages appearing from the fourth month onwards in the blood meal column, and for the fifth and six months with sulphate of ammonia, can only be attributed to denitrification due to the experimental tins becoming waterlogged with heavy storms of rain in the later part of the season. It is an accepted fact that if the soil

is very moist and nitrates are present, denitrifying bacteria liberate considerable quantities of free nitrogen gas. This was borne out by the percentages of total nitrogen recovered (nitric, ammonical, and organic) which diminished at the end of the sixth month to 28.4% in the case of the blood meal tins and to 48.1% in the case of the sulphate of ammonia tins.

(2) *Nitrate Content of Soils Green-manured under different conditions*.—It was mentioned at the end of the section of last year's Report dealing with the above matter that more extended work on the problem would be undertaken during 1937. Four sections of the Experiment Station were set aside for the purpose and each divided into six parts. These 24 parts were randomised and sown with sunnhemp at the rate of 20, 40, 60 and 80 lbs. per acre, so that there were six plots carrying each rate of seeding. Each of these plots was further sub-divided into three parts of area 1/60th acre and the crops on these handled as in the previous season, *viz.*, one set, the X plots, had the whole crop ploughed under towards the end of March. At the same time the tops on the second set of plots (the Y plots) were removed and the stubble on half of each ploughed under. On the third set (the Z set) the crop was left standing until mid-August, when the tops were removed and the mature stubble ploughed under, while, at the same time, the stubble left on the second half of each Y plot was also turned in.

Samples were taken to a depth of 6 inches from one quarter of the experimental area each week, so that every plot was sampled once per month. In all, approximately, 1,200 samples were analysed during the year for nitric nitrogen content. Cognisance was also taken of rainfall and of the daily soil temperature at 6 inches depth.

Concurrently with the above, two samples were taken each month from the previous year's plots. Here the nitric nitrogen content fell while the maize crop was growing, rose somewhat after reaping, and maintained a steady level throughout the winter until the first rains, the X plot being only slightly above the Y plot during that period.

It is not intended here to discuss these experiments, as the work is scarcely finished and the full results will be available shortly. It might be pointed out, however, that the

past year's work is bearing out what was noted on the 1936 plots, though not in quite such a marked degree. As regards rate of seeding, the 20 lb. application gave a distinctly lower nitric nitrogen production throughout the year, and again it would appear, when the analytical figures are studied in conjunction with the yields, that a 40-60 lb. rate of seeding is probably the optimum.

When methods of handling the green crop are considered, it is again to be noted that ploughing under the whole crop in March gives the highest production of nitric nitrogen throughout the winter, with the plots having the immature stubble ploughed under a close second. As regards the latter (the Y plots), very little difference could be seen in the different treatments accorded the half-plots, although those halves having the immature stubble turned in were, on the whole, very slightly higher than those with the stubble left standing. The Z plots showed an almost negligible amount of nitric nitrogen throughout the winter.

No account has been taken of the organic or ammoniacal nitrogen in the soils, as the experiments were designed solely with the purpose of tracing the history of the nitric nitrogen. The final effect of these treatments will be seen in the crops (maize) to which the plots have now been planted.

A full discussion of the experiments will shortly be available when the results have been collated and analysed.

(3) *Experiments on Chemistry of Soils, particularly C : N ratio, in soils under different conditions.*—The chemistry of the soil (and particularly the carbon-nitrogen ratio) as affected by different conditions and cultural treatments, formed the subject of this piece of research. It was desired chiefly to see what influence green-manuring had on the soil, as compared with soils under grass, and with soils to which no organic matter had been added. As the effects produced by different treatments, and particularly by cultivation, were thought likely to persist below the surface soil, samples were taken to a depth of 3 ft. 6 in. This depth is quite arbitrary.

Five pits in all were dug: their particulars follow:—

Pit 1.—In virgin soil under grass.

Pit 2.—In former ploughed land, now under grass for ten years.

Pit 3.—In land continuously ploughed and cropped, but neither fertilised nor green-manured.

Pit 4.—In land regularly cropped and green-manured: little or no fertiliser added.

Pit 5.—In land green-manured regularly and fertilised every other year with raw rock phosphate.

In each case the top soil was carefully sampled, but this was the only attempt at differentiating horizons, arbitrary layers of 9 inches being taken thereafter. Chemical and physical analyses were performed upon all samples.

The results of analysis indicate that the carbon and the nitrogen contents of the soil are best conserved under grass. The carbon-nitrogen ratio is similar in all soils, but the content of nitrogen, and of carbon particularly, is higher in those soils not cultivated. Continuous green-manuring to within recent years seems to have had no effect on the carbon and nitrogen contents of the soil. This is somewhat unexpected. The mechanical analysis reveals very little. The silt and clay content is lowest in the upper soil and increases with depth—at least to the depth chosen in these experiments. There is an indication that green-manuring increases the clay content in the lower layers. Iron mottling and staining is also more pronounced in the lower layers of green-manured soils.

Total exchangeable bases appear to be slightly—perhaps not significantly—higher in the upper layers of those soils under grass. But the total bases are greater in the lower layers of the cultivated soils than in those under grass.

A more detailed report of this experiment with the figures of analysis is in course of preparation.

(4) *Experiments in the Fire-proofing of Thatch.*—Tests were carried out with various chemical solutions on bundles of thatching grass, the grass being soaked in the solutions for standard times, dried in the sun and ignited along with untreated samples. None of the tests proved very satisfactory, and it was decided to try the product "Faspos" made by Imperial Chemical Industries Limited.

A hot solution of this compound of the strength recommended by the makers was prepared, bundles of grass soaked in it for various periods, dried and tested with a 3 inch bunsen flame. Charring took place, but no actual burning, and when the applied flame was withdrawn, even the smoulder disappeared. This took place with as little as 30 minutes' soaking.

Miniature huts were constructed, some with treated and some with untreated grass, certain of the untreated huts having the "Faspos" sprayed on to the exposed surfaces of the thatch. Untreated huts, when ignited, burned fiercely and collapsed in a very short time, while the sprayed huts showed a distinct disinclination to ignite, and it was not until the flame reached the inner stems, which had been protected from the spray, that the hut ultimately burst into flame. The huts built with treated grass proved very difficult to ignite even after receiving 0.75 inches of rain.

It would appear that the ideal method of using this preparation is to soak and dry the thatch before building, although tests showed that rain effects considerable removal of the protective coating, which would probably have to be restored after the rains are over.

Of all the solutions tested "Faspos" appeared to be the most satisfactory and to fulfil to a high degree the claims made for it by the manufacturers.

PASTURE RESEARCH STATIONS.

Marandellas.—Rainfall.—The rainfall for the season 1937 on this Station was 26.63 inches on 69 days. The total rainfall, as well as its incidence, was the most unfavourable ever recorded on the Station. There were two rather critical dry periods, the first of 20 days from 19th December, and the second of 21 days from 21st February. The effects of these are reflected in the yields of hay obtained, which are very much lower than those of 1936.

Yields of Hay.—The season 1936 was extremely favourable for the growth of hay, so that by comparison the yields from the year under review appear very low. It is therefore perhaps better to consider these yields in conjunction with those of

1935. It will be seen from the table below that the yields from all the paddocks, except the control, are lower than in 1935. This is to be expected, as no fertiliser treatment has been accorded them since 1933, although it is of interest to note that the N.P.K. and the P.K. paddocks still show the heaviest yields, the former being 92% and the latter 77% greater than the paddocks fertilised with raw rock, and 39% and 29%, respectively, greater than those fertilised with super alone. The influence of nitrogenous fertilisers in increasing hay yields has long been known, but the above results show that an appreciable increase has also been obtained by supplementing phosphatic fertilisation with applications of potash. This is further borne out from a study of the average yields (Table 1) obtained over seven years from the various paddocks. Another point which is clearly shown is that the influence of fertilisers on yields does not cease with the year of application or the following one, but can still be seen in the yields obtained three or four years after the last application. This is no doubt due to the fact that adequate fertilisation results in the establishment of a closer sward which is maintained in after years. It is also of interest to note that the beneficial influence of fertilisation on the hay yields is much more marked in years of poor rainfall than in favourable years. The control paddocks once more received 100 lbs. per acre sulphate of ammonia, and the yield is greater than that from the same paddocks in 1935, but is lower than that from the N.P.K. and P.K. groups in 1937.

TABLE 1.

Yield of Hay in lbs. from various Paddocks.

Treatment.	Average yield per acre for first five years.	Yield per acre 1935.	Yield per acre 1936.	Yield per acre 1937.	Average yield per acre for seven years.
N.P.K.	1,302	948	1,396	822	1,247
P.K.	992	823	1,297	761	1,003
Super	902	667	1,275	591	911
Raw Rock ...	794	658	762	429	737
Control	738	523	1,316*	641*	807

*Control paddocks received 100 lbs. per acre sulphate of ammonia in 1936 and 1937.

Results of Analyses of Hay Samples.—During the year 18 samples of hay were analysed, nine being from hay cut at the end of February, and nine from hay cut in the middle of April. The paddocks from which these latter samples were taken were grazed in the early part of the season, but, owing to the poor growth due to drought, the hay was not cut until very late, in order that a reasonable yield might be obtained. As a result, the hays cut in February were in general of higher feeding value than those cut in April. Compared with previous years, the average feeding value of the hays was better than in 1936, but not so good as in 1935.

This is in accordance with previous findings that in seasons of slow growth and poor yield the quality of the hay is better than in seasons of rapid rank growth and heavy yield.

The following table shows a comparison between the average feeding value of the hays from the old fertilised paddocks and the control paddocks for the past four years.

TABLE 2.

	Protein%.	K_2O%	P_2O_5%	Cl.%
1934—Fertilised	4.8	1.33	.37	.22
Control...	4.4	1.33	.32	.19
1935—Fertilised	5.8	1.81	.43	.27
Control...	4.7	1.73	.40	.19
1936—Fertilised	4.1	1.24	.38	.17
Control...	3.9	1.23	.30	.15
1937—Fertilised	4.3	1.35	.41	.20
Control...	4.6	1.40	.39	.16

It is interesting to note that the values for protein and potash from the control paddocks in 1937 are higher than those from the fertilised paddocks. This would indicate that the sulphate of ammonia has exercised a definite favourable influence on the quality of the pasture as well as increasing its yield.

Rhodes Grass.—In my Report for the year 1936 details were given regarding ten acres of Rhodes grass that were planted out in December, 1935, and reference was made to its high protein value during the first year. In January, 1937, this grass was fertilised with 100 lbs. superphosphate, 50 lbs. muriate of potash, and 50 lbs. sulphate of ammonia per acre.

The grass made excellent growth and was cut on 5th March, yielding 1½ tons of hay per acre. Despite the fact that the season was generally a very unfavourable one for hay, the yield from the Rhodes grass was approximately four times as great as the average yields obtained from the ordinary stumped paddocks on the Station during the previous years.

The analysis of the Rhodes grass hay showed that its protein value was considerably lower than that of the first year's hay, but nevertheless much greater than the ordinary fertilised veld hay cut earlier in the season.

Hay was also cut from a new block of thirty acres of Rhodes grass planted in January, 1937. Owing to the unfavourable season, the yield from this thirty acres was very poor, but analysis showed its protein content to be very similar to that of the first year's hay from the ten acres planted in December, 1935. The high feeding value of the first year hay is possibly due to the fact that the plants are not in very close association, and therefore have a greater feeding range than in the second year, when the sward is much denser. An interesting point brought out by the analyses of the various samples of the Rhodes grass hays is their high chlorine content. Practically all grasses in the Colony which have been analysed in these laboratories have been very poorly supplied with this element, but Rhodes grass is shown to have a chlorine content approximating that of grasses grown in Great Britain.

The following table shows the analysis of various samples of Rhodes grass hay compared with sunnhemp and soya bean hays grown under identical conditions

TABLE 3.

Analyses of Rhodes Grass, Sunnhemp and Soya Bean Hays.

Particulars.	Rhodes Grass, Marandellas, 1936. First Season.	Rhodes Grass, Marandellas, 1937. First Season.	Rhodes Grass, Marandellas, 1937. Second Season.	Rhodes Grass, Matopos, 1937. Second Season.	Sunnhemp, Marandellas, 1937.	Sunnhemp, Matopos, 1937.	Soya Beans, Marandellas, 1937.
Ash	7.31	7.39	5.53	8.36	5.01	4.80	6.37
Acid Soluble Ash	5.65	5.37	4.28	4.41	4.66	4.35	5.24
Ether Extract	.94	1.57	1.11	1.21	1.23	1.14	3.55
Fibre ...	41.47	36.16	40.45	39.72	44.13	47.72	27.20
Crude Protein	8.61	8.53	5.81	5.20	11.77	10.32	13.66
CaO	.40	.45	.46	.21	.65	.92	1.38
K_2O	3.40	2.68	2.15	.87	2.00	1.50	1.50
P_2O_5	.44	.33	.27	.50	.38	.22	.40
Cl.	.90	1.06	.94	.97	.18	.17	.03

Feeding Experiment with Sunnhemp Hay, Rhodes Grass Hay and Veld Hay.—Object.—The object of the experiment was to determine the relative feed value to young animals of a ration consisting entirely of either sunnhemp hay, Rhodes grass hay, or ordinary veld hay.

Method.—Twelve approximately two-year tollies on the Marandellas Station were divided into three groups, each group being as nearly equal in weight as possible. The animals were enclosed in small paddocks and were given free access to water and a salt and iron lick.

The various hays were fed *ad lib.* and the animals were weighed every two weeks.

The animals in the sunnhemp group showed a great reluctance to eat the hay at the commencement of the experiment, but after about two weeks consumed it quite readily. This reluctance to eat the hay naturally caused a considerable fall in the weights of the animals during the first two weeks, and the average loss amounted to 41 lbs. per beast.

The experiment commenced on 11th May and terminated on 7th September, a period of 120 days. Owing to the small amount of sunnhemp available, the group receiving this hay had to be eliminated after 75 days, when the hay was all used up. The analysis of the sunnhemp and Rhodes grass hays used is shown in columns 3 and 5 of Table 3.

Table 4 shows the initial and final total weights of each group.

TABLE 4.

	Weight in lbs. 11.5.37.	Weight in lbs. 26.7.37.	Loss in weight in 75 days.—lbs.	Weight in lbs. 7.9.37.	Loss in weight in 120 days—lbs.	Hay consumed. lbs.	Average amount of hay eaten per day per beast.
Sunnhemp ..	3,443	3,322	121	—	—	3,982	13 lbs.
Rhodes Grass	3,449	3,258	191	3,293	156	7,724	16 lbs.
Veld Hay ...	3,456	3,234	222	3,118	338	6,880	14 lbs.

It will be noted from the above table that, despite the initial setback, the animals on sunnhemp hay after 75 days lost on the average only 30 lbs. per beast, as against 48 lbs. in the Rhodes grass group and 55 lbs. in the veld hay group. In actual fact the animals in the sunnhemp group, after the first two weeks in which they lost an average of 41 lbs. each, really gained slightly in weight during the next 60 days. After 120 days the loss in weight of the animals on Rhodes grass hay averaged 39 lbs. against 84.5 lbs. per beast in the veld hay group. During the last 45 days of the experiment, therefore, the animals in the Rhodes grass group actually gained in weight, whereas those on veld hay steadily lost weight. It should be noted that the weather was extremely cold during the first part of the experiment and comparatively warm during the last month, which is the probable explanation for the Rhodes grass animals gaining in weight during the last 45 days of the experimental period. The continued loss in weight of the veld hay group of animals is undoubtedly due to the poor quality of the hay, which was of insufficient feed value to supply their maintenance requirements. Owing to its fibrous nature and possible unpalatability, it is doubtful perhaps whether sunnhemp hay is as suitable for feeding

purposes as other common legume hays, but this experiment definitely indicates that when necessity arises it can safely be fed to stock, and, despite its fibrous nature, is of superior feeding value to ordinary veld hay and can supply the maintenance requirements of a growing animal. Rhodes grass hay is not only more palatable, but is also of superior feed value to veld hay, and under favourable conditions suffices to supply the maintenance requirements of young tollies. Ordinary veld hay of the nature obtainable on the Pasture Station at Marandellas is of insufficient feed value to supply the maintenance requirements of young growing animals.

Experimental Animals, Marandellas.—The experiments laid down to determine the influence of the feeding of various mineral licks to the grazing animals are being continued.

The limited quantity and low feeding value of the hay available during the past season were reflected in the condition of all the animals on the Station. Although all the animals lost condition badly, no deaths occurred from poverty, and as soon as new grass became available all gained rapidly in weight. The feeding value of the veld herbage on this Station, even when cut under most favourable conditions, is too low to provide the animals with sufficient calories to supply their maintenance requirements, and, therefore, without some supplementary feeding, animals are bound to lose weight during the winter months.

The feeding of mineral licks, while correcting mineral deficiencies and possibly aiding digestion, cannot replace or make good deficiencies in the organic or energy-producing ingredients of the ration.

It is markedly noticeable, however, that all the animals in the mineral groups, even when in poor condition, appear to have much more energy and life than those in the non-mineral groups, and pick up in condition much more rapidly when new grass is available. At the present stage there is very little difference between the groups receiving the various mineral licks, although both the young stock and cows in all the mineral groups are markedly superior to those in the non-mineral group.

It has been pointed out in previous Annual Reports that animals showing the most visible symptoms of a mineral

deficiency on the Marandellas Station are milking cows, although symptoms may appear in young growing animals mainly in the form of stunted growth and general unthriftiness.

Owing to the fact that only two cows in the non-mineral group calved during the past season, the group as a whole is in much better condition than during the previous three years. Most of the cows in this group have just calved, or will calve, within the next few weeks, and in those that have already calved similar symptoms of malnutrition to those described in previous Reports are already appearing. The young stock in this group are very poorly developed compared with those in the mineral groups, despite the fact that their grazing and the hay is the best on the Station.

It is of interest that a young two-year-old heifer in this group weighed only 197 lbs. and died on 20th October. *Post-mortem* examination proved definitely that the cause of death was general anaemia. The average weight of three other two-year-old heifers in this group is only 320 lbs., as compared with an average weight of 500 lbs. for similar animals in the various mineral groups.

Sixteen young steers were sold from the Station during the year.

Six of these animals, just under three years of age and weighing an average of 1,000 lbs. each, were sold in the local market for £6 each. The remaining 10 were later stall-fed for three months and sold to the Rhodesian Export & Cold Storage Company, Limited, as "chillers."

These animals when sold were of an average age of $3\frac{1}{2}$ years and averaged 1,190 lbs. in weight when sent off the Station; the cold dead weight amounted to 52.4% of the weight when despatched and all carcases were graded "Imperial."

Matopos.—Rainfall.—During the season under review the rainfall amounted to 20.33 inches on 40 days. The rainy season started early, but was followed by very prolonged drought periods, which resulted in a very poor growth of grass up to the middle of January. There were 16 dry days between 23rd November and 8th December, and then from 16th December to 24th January there was a dry period of 38 days.

Rain amounting to 7.44 inches fell on 16 days in February, and this enabled the pastures to grow rapidly, so that, although there was a further dry period of 30 days up to 22nd March and no rain after the end of March, comparatively satisfactory crops of hay were obtained.

Yields of Hay.—Blackland Paddocks.—The soil in these paddocks is derived from schist and overlies granite. It is of a very clayey nature and during the rare periods of heavy rainfall is extremely sticky and cannot be used for grazing purposes.

The grass in the paddocks is sweet and of a relatively high nutritive value.

During the long dry season huge cracks develop in the soil owing to the shrinking of the clay, and this naturally has a very adverse effect on the grass cover, as the root systems of many of the plants become exposed and dry out. In areas of good rainfall, soils of this nature would undoubtedly prove very fertile, but, owing to the extremely erratic precipitation that has been experienced at Matopos during the past six years, the grass cover in these paddocks has suffered rather badly. The favourable rainfall in 1936 improved the paddocks tremendously, and therefore, despite the poor precipitation in 1937, fair yields of hay were obtained. The drastic effects of the prolonged droughts on these paddocks makes the interpretation of the results of fertilisation somewhat difficult, as, despite the fact that the soils in the various paddocks are very uniform in nature, certain paddocks have undoubtedly been more adversely affected than others by the drought periods, probably mainly due to the slight slope of the land.

In the following table the yields of hay obtained since 1930 are recorded. The years 1932, 1933 and 1934 were exceedingly bad drought years, and this is, of course, reflected in the yields of hay obtained. Although the paddocks have recovered to a large extent during the past three years, the yields of hay are still considerably below those obtained during the years 1930 and 1931. The paddocks fertilised in the years 1930, 1931 and 1932 with phosphate and potash appear to have made the best recovery.

During the seasons 1936 and 1937 the old control paddocks were fertilised at the rate of 100 lbs. per acre with sulphate of ammonia, and, as will be seen from the following table, this treatment has exercised a strikingly beneficial effect on the hay yields.

TABLE 5.

Yields of Hay in lbs. from Blackland Hay Paddocks.

Treatment.	Average 1930 & 1931.	Average 1932, 1933 & 1934.	Yield 1935.	Yield 1936.	Yield 1937.	Average for 8 years.
N.P.K.	2,022	439	1,015	1,103	1,244	1,090
P.K.	1,585	444	1,004	1,490	1,420	1,040
Super...	1,627	407	1,067	1,022	1,533	1,012
Raw Rock ...	1,560	435	751	1,463	1,295	992
Control	1,647	470	832	1,387*	1,337*	1,033

*Control paddocks received 100 lbs. per acre sulphate of ammonia in 1936 and 1937.

Influence of Ploughing the Blackland on the subsequent Yields of Hay.—In order to determine the influence of ploughing the blackland as a possible method of pasture regeneration, an exceptionally poor area of two acres in an extra control paddock was ploughed up in the winter of 1935, and allowed to self seed. Despite the fact that the season in 1935 was a very short one and that no rain fell after 10th February, 1936, the ploughed area produced a good growth of grass, and 2,390 lbs. of hay per acre were reaped from the ploughed two acres, as against 1,417 lbs. per acre from the whole ten-acre paddock.

In 1937 the same ploughed area gave a yield per acre of 2,792 lbs. of hay as against 1,511 lbs. per acre over the whole paddock. The grass on the ploughed area consisted mostly of annual grasses during the first season after ploughing, but during the second year a large variety of perennial grasses were found, the dominant grass being Purple Timothy (*Setaria porphyrantha*).

The experiment shows that ploughing of this heavy black soil represents an excellent method of regenerating the pasture. The average yield of hay per acre in the paddock during the

most favourable years of 1930 and 1931 was 1,324 lbs., whereas in the two years after the ploughing the average yield per acre was raised to 2,591 lbs.

Yields of Hay. Sandveld.—Reference has been made in previous Annual Reports to the fact that the sandveld section at Matopos is much less adversely affected by unfavourable weather conditions than the blackland section.

In all respects the influence of fertiliser treatment, controlled grazing and cutting have proved much more satisfactory and understandable than in the case of the blackland paddocks. It is of interest that this area which was considered to be comparatively valueless when the Station was first laid down has, in actual fact, proved to be almost as productive as the area laid down on the heavy and more potentially fertile soil. From the point of view of grazing the sandveld has proved invaluable, as it could be used during the periods of heaviest rainfall when the blackland paddocks were in a water-logged condition. Although the hay from the sandveld is of inferior quality to that on the blackland, in years of drought the sandveld is more certain of producing a yield and responds much more quickly to a light rainfall than the heavy black soil.

A comparison of the following table with that giving the yields from the blackland paddock shows that the sandveld paddocks, although very poor at the commencement of the experiment, are now very comparable with those of the blackland paddocks.

TABLE 6.

Yields of Hay in lbs. per acre from Sandveld Paddocks.

Treatment.	1931.	1932.	1933.	1934.	1935.	1936.	1937.	Average for 7 years
N.P.K.	956	454	769	952	1,132	1,396	1,172	976
P.K.	608	286	327	941	1,160	1,679	1,338	906
Super	624	343	362	793	1,079	947	1,101	750
Raw Rock ...	—	284	291	951	955	935	905	720†
Control	483	244	251	797	913	843*	1,425*	708

*Control paddocks received 100 lbs. per acre sulphate of ammonia in 1936 and 1937.

†Raw Rock for six years only.

Sandveld.—The striking fact about the yields from the sandveld is the increase in the yield from the control paddock in 1937 compared with 1936. The actual yield amounted to 1,425 lbs. per acre, an increase of 69%, and is higher than that from any of the other paddocks. The yield from the super paddock is slightly greater than in 1936, but on all the other treatments there has been a drop compared with the previous year.

As the rainfall in 1936 was more favourable than in 1937, the marked increase in the yield from the control paddock may be stated as being due to the sulphate of ammonia applied during the past two seasons.

Results of Analysis.—There were 21 samples of hay from the paddocks analysed from this Station during the year; 12 samples were from the blackland area and nine from the sandveld.

TABLE 7.

Mean Analyses of Hay from Blackland Paddocks.

Year.	Protein %	K_2O %	P_2O_5 %
1935—Mean of fertilised	4.59	1.21	.27
Mean of control	4.03	.96	.17
1936—Mean of fertilised	7.02	1.42	.45
Mean of control*...	5.90	1.32	.25
1937—Mean of fertilised	5.23	1.24	.35
Mean of control*...	4.92	1.30	.26

*Control paddocks received 100 lbs. per acre sulphate of ammonia in 1936 and 1937.

Compared with previous years, the mean of the feeding value of the hay from the various paddocks lies intermediate between those for 1936, which were very good, and those for 1935, which were about normal. It should be noted, too, that as a result of the applications of sulphate of ammonia to the control paddocks, their feeding value is almost equal to that from the previously fertilised paddocks, whereas in former years the difference was much more marked.

TABLE 8.

Mean Analyses of Hay from Sandveld Paddocks.

Year.	Protein %	K_2O %	P_2O_5 %
1935—Mean of fertilised	4.7	1.58	.42
Mean of control	4.0	1.39	.24
1936—Mean of fertilised	5.78	1.67	.45
Mean of control*...	7.40	1.83	.42
1937—Mean of fertilised	3.72	1.23	.46
Mean of control*...	3.66	1.31	.53

*Control paddocks received 100 lbs. per acre sulphate of ammonia in 1936 and 1937.

The feeding values of the hays from this area are markedly poorer, except in phosphate, than those from the blackland and from Marandellas. As has also been noted in the case of the hays from the control paddocks in the blackland area and Marandellas paddocks, their feeding value now approximates closely to that from the fertilised paddocks. In fact, in this instance, the control samples are superior in all respects except protein, in which they are almost equal.

Experimental Animals, Matopos.—As mentioned in my Report for 1936, the experimental work at this Station was seriously handicapped owing to the fact that the majority of the animals under experiment were situated in the area quarantined on account of East Coast Fever.

Although no mineral craving had ever evidenced itself among animals grazing on this Station, an experiment was laid down in April, 1936, to determine whether the feeding of licks to these animals would exercise any influence on their live weight, particularly during the dry season when the grazing was limited and their main source of food was veld hay. The experiment was commenced in April, 1936, and in May, 1936, the area in which the animals were grazing was placed in quarantine; the experiment was nevertheless continued, although the animals could not be brought to the weighbridge.

Twenty-nine breeding cows of a very uniform type and age were divided into three groups, two groups containing 10 animals, and one group nine animals, these groups being as comparable as possible. The animals were all grazed together during the day, but were kraaled in their respective groups at night and during the winter months were fed hay *ad lib.*

One group was allowed free access to a lick composed of ordinary salt and iron oxide; a second group was supplied in the same manner with a lick containing salt, iron oxide, and potassium chloride; and the third group received no lick. At the commencement of the experiment the animals showed little interest in the licks, but later consumed them quite readily, but in very varying quantities.

The animals were weighed at the commencement of the experiment, but not again until the quarantine restrictions were raised fourteen months later, and thereafter fortnightly until the experiment ceased on 30th October, 1937.

The following table shows the average weights of the animals in each group at the beginning of the experiment, fourteen months later, and at the end of the experiment.

Date.	Salt & Iron Group. Average weight. lbs.	Salt, Iron & Potash Group. Average weight. lbs.	Control Group. Average weight. lbs.
30.4.36	974	1,007	1,029
30.6.37	935	997	976
30.10.37	787	828	825
Average loss in weight ...	187	179	204

Although the average loss in weight of the control animals is slightly greater than that of the animals in the mineral lick groups, this difference is not significant and is within the limits of experimental error. Every cow, with the exception of one in the salt and iron group, calved once during the course of the experiment.

The fact that all the animals at the end of the experiment were much lighter in weight than at the commencement is only to be expected, as no supplementary feeding was carried out, the animals existing during the whole experiment on grass or hay alone. At the beginning of the experiment the animals were in their best condition for the year and at the end had just gone through the whole of the dry season and were therefore at their worst.

The results of this experiment therefore tend to indicate that if any salt deficiency exists in the grass or hay growing in this area it is not sufficiently marked to reflect itself significantly in the live weight increases or decreases of fully grown breeding cows. It must, however, be pointed out that the grazing available to these animals is of rather exceptional quality. A permanent stream of water runs through the grazing area and a certain amount of green grass is available right throughout the year. In addition, the hay fed was mainly obtained from land similar to that existing in the blackland paddocks, which produces a grass of considerably better feeding value than that found on sandveld. It is always possible that different results might have been obtained had the experiment been carried out on pastures similar to those existing in the sandveld in the same district. As the Pasture Station at Matopos has now definitely been closed down, it will remain for a Department other than this to investigate problems of this nature.

During the year eight steers, $3\frac{1}{2}$ years old and born on the Station, were fattened and sold to the Rhodesian Export & Cold Storage Company, Limited, for slaughter as "chillers." Five of these animals were graded "Imperial" and three "Standard." Their average weight when despatched was 1,181 lbs., and their cold dead weight 53% of the live weight.

Rhodesia Weather Bureau.

APRIL, 1938.

Pressure.—Barometric pressure was generally remarkably low, averaging nearly two millibars below normal. Bulawayo average pressure is the lowest recorded in 35 years, the next lowest being 869.8mbs in 1908.

Temperature.—Maximum, minimum and mean temperatures were all very high, the average mean temperature being 4° above normal in the south and east and over 2° above normal in the north.

Bulawayo mean maximum 82.3° was the highest on record, the next being 81.7° in 1914. Bulawayo mean minimum was also the highest on record, 57.7°, the next highest being 57.6° in 1925.

Rainfall.—Rainfall was generally rather above normal, particularly in the Limpopo Valley, where useful rains were recorded.

PRECIPITATION.

Station.	Inches.	Normal.	No. of days.
Beitbridge...	2.71	0.41	4
Bindura	0.81	1.61	6
Bulawayo	0.95	1.73	4
Chipinga	0.73	2.33	7
Enkeldoorn	1.15	0.72	5
Fort Victoria	0.75	0.63	3
Gwaai Siding	1.54	1.38	2
Gwanda	2.00	0.67	4
Gwelo	0.52	0.75	4
Hartley	2.39	0.87	6
Inyanga	3.05	1.23	10
Marandellas	1.78	1.43	4
Miami	0.79	1.39	2

Station.	Inches.	Normal.	No. of days.
Mount Darwin	1.01	0.52	5
Mount Nuza	5.82	5.19	15
Mtoko	2.71	0.61	3
New Year's Gift	0.17	1.02	3
Nuanetsi	3.10	0.62	5
Plumtree	1.08	1.15	4
Que Que	1.04	0.73	3
Rusape...	0.68	1.20	3
Salisbury	1.33	1.05	5
Shabani...	1.32	0.60	5
Sinoia	0.26	0.95	2
Sipolilo...	1.23	1.19	3
Stapleford	4.03	3.82	12
Umtali	1.94	1.14	6
Victoria Falls	0.91	0.59	3
Wankie	0.27	0.62	4
Abercorn	1.15	—	7
Broken Hill	1.31	—	7
Chitambo	3.63	—	8
Choma	0.81	—	6
Fort Jameson	5.48	—	12
Fort Roseberry	5.66	—	6
Isoka	3.07	—	5
Kalomo	0.17	—	1
Kanchindu	0.62	—	4
Kapiri Mposhi...	1.45	—	7
Kasama...	2.45	—	7
Livingstone	0.75	—	3
Lundazi	5.74	—	11
Lusaka	0.90	—	3
Mazabuka	1.11	—	3
Mongu	4.50	—	7
Mpika	1.53	—	5
Mufilira...	0.77	—	5
Mumbwa	0.31	—	3
Namwala	0.32	—	2
Ndola	1.04	—	10
Petauke	4.66	—	15
Shiwa Ngandu	3.38	—	12

APRIL, 1938

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	8-30 a.m. Wet Bulb.	8-30 a.m. Dew Point	8-30 a.m. Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute Maximum : Date	Absolute Minimum : Date	Number of Days Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
›ridge...	1,500	73.6	67.5	64	7.6	87.3	64.6	76.0	100 : 1st	59 : var	22	...	12	...	75.5	963.7	881.7	...	3.7	...
ura...	3,700	67.8	63.4	61	5.3	80.7	60.4	70.5	85 : 21st	56 : var.	...	...	...	...	70.2	892.4	882.2	...	4.7	...
wayo	4,393	68.6	60.5	55	8.8	82.3	57.7	70.0	89 : 21st	54 : 7th	4	...	...	...	69.5	869.5	880.9	867.9	3.5	9.2
inga	3,685	71.6	63.6	59	9.5	80.3	59.3	69.8	88 : 1st	55 : 17th	2	...	...	...	69.0	892.6	882.2	...	3.3	...
›ldoorn	4,788	67.2	60.9	57	7.0	79.9	56.9	68.4	86 : 21st	52 : 16th	1	...	...	...	66.7	857.6	881.2	...	3.2	...
Victoria... ...	3,571	70.5	63.1	59	8.6	84.1	57.4	70.7	91 : 21st	52 : var.	10	...	...	...	69.8	895.3	881.3	...	2.5	...
ai Siding... ...	3,278	70.9	62.9	58	9.4	89.6	57.9	73.7	95 : 22nd	50 : 30th	28	...	1	...	...	903.9	880.7	...	1.8	...
nda...	3,233	71.5	63.1	58	10.0	84.8	61.3	73.1	92 : 21st	55 : 30th	13	2	4	...	71.9	906.0	881.3	...	2.4	...
lo	4,629	68.9	61.3	56	8.5	81.5	57.5	69.5	87 : 22nd	53 : 27th	3	...	...	...	69.3	862.3	880.9	...	3.3	...
ley...	3,879	69.3	62.9	59	7.5	82.5	57.2	69.8	88 : 22nd	50 : 30th	2	1	...	...	69.6	885.6	881.0	...	2.2	...
nga...	5,503	66.8	59.4	54	8.0	76.1	52.8	64.5	81 : 21st	48 : var.	...	...	...	...	62.2	...	...	...	2.7	...
andellas	5,453	64.5	59.4	56	5.4	75.6	56.3	66.0	80 : 21st	52 : 17th	...	...	...	...	65.7	...	...	...	1.8	...
mi	4,090	67.9	63.5	61	5.2	79.7	59.7	69.7	84 : 21st	55 : 30th	...	...	...	...	69.1	878.9	881.0	...	3.5	...
Darwin	3,179	70.4	65.3	63	6.2	82.8	60.8	71.8	87 : 21st	54 : 30th	6	...	4	...	70.6	907.9	...	...	5.8	...
nt Nuza	6,668	58.4	54.4	51	3.8	64.9	52.0	58.5	70 : var.	48 : var.	...	27	...	...	56.9	802.1	881.5	...	5.7	...
ko	4,141	68.9	63.1	60	7.0	77.9	59.8	68.8	83 : 21st	55 : 30th	...	...	...	...	68.6	878.2	881.9	...	4.3	..
Year's Gift...	2,690	71.8	64.9	61	8.4	86.1	58.3	72.2	94 : 1st	53 : 17th	17	...	1	...	...	...	...	...	...	8.3
netsi	1,581	72.7	67.5	65	6.4	87.6	61.6	74.6	100 : 1st	54 : var.	23	...	8	..	...	961.6	881.7	...	5.5	...

APRIL, 1938 (continued)

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	8-30 a.m. Wet Bulb.	8-30 a.m. Dew Point	8-30 a.m. Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days Max. > 85°	Max. < 70°	Min. > 65°	Min. ≯ 40°	Mean of 24 hours	Pressure Millibars 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
lumtree	4,549	69.9	60.5	54	10.7	81.9	60.1	71.0	88	21st	57	var.	4	1	...	...	70.9	864.6	880.8	...	2.4	...
ue Que	3,999	68.7	62.3	59	7.6	84.7	58.7	71.7	90	21st	53	30th	11	...	...	...	71.4	881.9	881.1	...	1.8	...
usape	4,648	65.9	60.6	57	6.0	79.5	55.6	67.5	85	21st	49	30th	...	...	..	...	66.4	..	...	...	2.7	...
alisbury	4,831	66.8	61.1	57	6.4	78.9	56.3	67.6	84	21st	51	16th	...	...	...	...	66.4	856.6	881.3	855.1	3.4	9.0
habani	3,131	73.2	64.2	59	11.0	85.4	60.7	73.1	92	21st	54	30th	14	...	3	...	...	...	...	...	2.8	...
inoia	3,795	69.9	63.6	60	7.6	84.8	56.5	70.7	90	22nd	51	12th	9	...	...	...	69.8	888.7	881.6	...	2.7	...
ipolilo	3,876	70.2	63.7	60	7.6	80.1	59.7	69.9	85	21st	56	var.	...	...	...	...	...	885.5	881.2	...	3.4	...
apleford	5,304	62.8	59.3	57	3.7	70.5	50.5	60.5	77	21st	39	30th	...	11	...	1	61.0	842.7	881.8	...	4.0	...
mtali	3,672	69.0	64.4	62	5.5	82.0	58.5	70.3	89	var.	51	29th	3	...	...	...	68.1	893.1	882.2	891.7	3.5	9.3
ictoria Falls... ...	3,009	73.6	65.5	61	9.9	92.3	61.3	76.8	98	22nd	53	30th	30	...	7	...	75.4	911.5	880.6	...	2.2	...
'ankie...	2,567	76.4	66.8	61	12.1	93.6	66.9	80.3	98	2nd	62	var.	30	...	20	...	80.2	926.5	880.7	...	1.0	...
bercorn	5,407	66.8	62.3	60	5.3	76.6	59.3	67.9	81	20th	56	23rd	...	...	...	...	...	837.4	380.3	...	3.8	...
alovale...	3,400	...	...	...	...	...	...	...	...		...		...	...	...	...	...	...	...	...	...	...
oken Hill	3,920	68.5	64.7	63	4.8	82.8	59.8	71.3	87	24th	52	30th	4	...	...	...	...	883.8	880.0	...	3.9	...
ipili	3,900	67.7	65.4	64	2.7	83.3	63.6	73.4	86	var.	58	30th	5	...	5	...	...	...	...	...	...	...
ort Jameson ...	3,620	72.6	67.0	64	7.0	86.0	64.6	75.3	90	23rd	59	30th	17	...	9	...	...	887.7	881.5	...	2.6	...
oka...	4,210	69.6	65.0	63	5.4	78.5	64.6	71.5	82	21st	60	20th	...	...	8	...	...	...	...	...	...	...
asamia...	4,700	68.0	64.4	63	4.2	80.5	61.2	70.9	82	var.	58	28th	...	...	...	...	...	864.1	880.7	...	...	...

APRIL, 1938 (continued)

Station	Altitude (Feet)	Temperatures in Stevensons Screen at 4 feet °F: 8-30 a.m. Dry Bulb	Wet Bulb.	Dew Point	Vapour Press. Deficit	Maximum	Minimum	Max. + Min. ÷ 2	Absolute: Maximum	Date	Minimum	Date	Number of Days: Max. > 85°	Max < 70°	Mim > 65°	Min < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm	Mean of 24 hours	Cloud Tenths	Sunshine Hours
mpa	4,500	68.9	65.2	63	4.4	82.0	57.9	70.0	85	2nd	48	29th	...	...	...	...	...	...	...	...	...	...
gstone	3,140	70.0	64.0	61	7.1	91.6	60.3	75.9	97	21st	55	30th	30	...	2	...	...	906.5	880.2	...	3.5	8.9
shya	4,000	66.4	63.3	62	3.4	85.0	61.0	73.0	90	21st	56	27th	12	...	...	...	...	...	...	...	...	...
nchi	...	67.4	64.1	62	3.9	76.9	62.4	69.7	80	20th	58	30th	...	...	1	...	...	...	...	...	...	...
buka Res. ...	3,385	71.2	65.0	61	7.5	86.1	62.2	74.1	91	22nd	56	16th	16	...	3	...	...	900.0	880.1	...	2.4	9.3
shi	3,700	...	...	...	...	...	...	...	...		...		...	...	...	...	...	...	...	...	...	...
gu	...	72.2	66.6	63	6.8	87.8	65.6	76.7	91	28th	61	30th	25	...	12	...	...	896.6	879.6	...	2.4	...
ka	4,625	67.2	63.7	62	4.0	78.1	60.6	69.4	82	25th	56	30th	...	...	...	...	...	862.3	880.9	...	5.0	...
lira	4,200	68.8	65.2	63	4.4	83,8	59.9	71.8	87	21st	54	var.	8	...	...	...	...	...	...	...	...	...
bwa	3,500	70.0	64.9	62	6.1	83.1	57.5	70.3	88	21st	50	30th	5	...	...	...	...	...	...	...	...	...
nzo Mission ...	5,000	...	...	...	...	...	...	...	...		...		...	...	...	...	...	...	...	...	...	...
nilunga	4,450	65.0	63.7	63	1.5	80.3	59.5	69.9	83	25th	50	30th	...	...	...	...	...	...	...	...	...	...
la	4,140	67.4	64.4	63	3.6	81.4	59.9	70.6	84	25th	53	30th	...	...	...	...	...	875.2	880.2	...	3.9	...
nje	4,700	66.5	62.7	61	4.6	78.7	60.6	69.7	84	20th	53	30th	...	...	...	...	...	...	...	...	...	...
ezi	4,450	...	...	...	...	...	...	...	...		...		...	...	...	...	...	...	...	...	...	...

Southern Rhodesia Veterinary Report.

MARCH, 1938.

DISEASES.

Anthrax was diagnosed on the Central Estates, Chilimanzi native district. Mortality, two head of cattle.

African Coast Fever diagnosed on the farm Holland, Melsetter native district.

TUBERCULIN TEST.

One bull was tested upon importation with negative results.

MALLEIN TEST.

Twenty-two horses were tested. No reactions.

IMPORTATIONS.

From the Union of South Africa.—Bulls 1, horses 15, sheep 293.

From the Bechuanaland Protectorate.—Sheep 1,335.

EXPORTATIONS.

To the Union of South Africa.—Oxen 44.

To Northern Rhodesia.—Oxen 120, bulls 10, sheep 91.

To Portuguese East Africa.—Oxen 51, cows 53.

To Bechuanaland Protectorate.—Horses 7.

To Congo Belge.—Pigs 1, sheep 56.

EXPORTATIONS.—MISCELLANEOUS.

To the United Kingdom.—Chilled beef quarters, 4,523; frozen boned beef quarters, 4,939; kidneys, 1,185 lbs.; tongues, 7,221 lbs.; livers, 16,759 lbs.; hearts, 6,023 lbs.; tails, 2,389 lbs.; skirts, 3,277 lbs.; shanks, 11,690 lbs.

To Northern Rhodesia.—Frozen beef carcases, 216¾; frozen pig carcases, 74.

To Congo Belge.—Frozen beef carcases, 371¼; frozen mutton carcases, 15; frozen pig carcases, 15; frozen veal carcases, 26.

Meat Products.—From Liebig's Factory: Corned beef, 133,018 lbs. to the Union of South Africa.

G. C. Hooper Sharpe,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-38.

Monthly Report No. 65. April, 1938.

The appearance of the first winged individuals of the new generation of the Red Locust (*Nomadacris septemfasciata*, Serv.) was reported on the 7th April.

Destruction of hoppers has been continued in the various districts concerned, but at the end of the month most of the surviving hoppers appear to have matured.

The winged swarms have not been much in evidence, although the weather has been warm, but an interesting report from the Bulawayo Observatory on the 20th referred to locusts passing over "at a great height" from N. to S. on three consecutive days.

In general, the number of locusts maturing in the Colony is relatively small and the position appears to be much the same as at the same time last year.

RUPERT W. JACK,
Chief Entomologist.

THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.
(Assisted by the Staff of the Agricultural Department).

PUBLISHED MONTHLY.

Subscription: 5/- per annum; payable to the Accountant, Department of Agriculture, Salisbury.

VOL. XXXV.] JULY, 1938. [No. 7.

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Horse-sickness Inoculation.—Vaccine for the inoculation of horses and mules of any age against horse-sickness will be issued from now onwards until the 1st November at a cost of 6s. per dose, post free.

Immunity does not reach its height until several months after inoculation and owners are therefore urged not to wait until the end of the inoculation season but to inoculate as early as possible.

The vaccine must be used within seven days of its despatch from the Laboratory and will be issued direct to applicants, who will be required to do or arrange for the inoculation themselves.

Angular Spot or Blackfire of Tobacco.—In the Journal of Agricultural Research for December, 1937, an interesting article by E. E. Clayton appeared in the water soaking of tobacco in relation to the development of angular spot, known in the American literature as blackfire. A number of experiments were conducted which indicate that infection by *Bacterium angulatum* is not general unless the tobacco leaves are water soaked for a considerable time. Even heavy storms when followed at once by clear weather are not effective in producing angular spot infection to any serious extent. Long dull spells with rain at intervals or very wet seed-beds with insufficient ventilation, on the other hand, provide conditions suitable for the rapid development of angular spot. The discussion and summary of the experiments are as follows:—

The results secured in these experiments with blackfire caused by *Bacterium angulatum* are similar in every respect to those previously reported for wildfire, and it seems clear that with types of tobacco grown in the United States epidemic development of blackfire is dependent on water soaking of the leaves. Water soaking breaks down host resistance and permits successful and rapid tissue invasion by the organism.

Bacterium angulatum, while similar in mode of action to *Bacterium tabacum*, is evidently a less virulent parasite. Thus throughout the work in parallel experiments, infection with *Bact. angulatum* in the absence of water soaking was less easy to secure and the infections were less numerous, developed more slowly, and were smaller; with water soaking and more favourable conditions, these differences still persisted though they were not so marked. With favourable conditions, both organisms can practically destroy a crop in a short time.

Some degree of blackfire protection can be secured by high topping, and low-nitrogen and high-potash fertilisation is also helpful, but these practices can be applied only in areas where the type of tobacco grown will permit. They are applicable to the flue-cured area.

However, it is evident that effective blackfire control must be sought by other means, and the most promising of these are (1) sanitation and other measures designed to eliminate sources of infection and (2) development of varieties still more

resistant to the disease than those now available. In the latter connection it is to be noted that varieties grown in the United States are practically all moderately resistant to blackfire, which accounts for the fact that they suffer little damage from the disease until this resistance is broken down by the conditions incident to heavy storms.

Tobacco leaves are readily infected by *Bacterium angulatum*, but under ordinary conditions invasion is limited to small areas. The lesions are usually one-eighth of an inch or less in diameter, and large numbers of infections cause but little damage to most types of tobacco.

It has been suggested that the large quickly developing lesions characteristic of epidemic blackfire were non-parasitic in nature; but it is now shown that they are caused by *Bact. angulatum*, but only under special conditions. The resistance of the leaf to the invasion must first be broken down by water soaking, which in turn results from severe storms.

Even after leaves are water soaked, however, the infection has occurred, the development of the disease is abruptly checked if the water-soaked condition disappears within a few hours. Epidemic disease development was repeatedly obtained by water soaking the leaves for 48 hours. Resistance of the leaves to water soaking, and hence to the disease, has been shown to be greatly modified by topping and fertilisation practices. High topping and low nitrogen and high potash fertilisation increase leaf resistance to water soaking, and these measures are recommended as practicable in the flue-cured tobacco area of the U.S.A.

Tobacco Intelligence.—*Tobacco Intelligence,* the first number of which was issued by the Imperial Economic Committee in May, 1938, is a quarterly publication designed to supply a regular service of information on tobacco production, consumption and trade.

In 1937 over 182 millions pounds of tobacco went into the cigarettes, pipe tobacco, cigars, etc., manufactured in the United Kingdom and Empire tobacco accounted for 24 per

cent. of this total. Growers in India, Canada, Southern Rhodesia and Nyasaland, supplying most of this Empire tobacco, want to know how their competitors, Empire and foreign, are faring. *Tobacco Intelligence* therefore provides news about the crops in India, Canada, Southern Rhodesia, Nyasaland and the United States and the export movement of tobacco from these countries.

Consumption in the United Kingdom is fully analysed. A special article shows that 1937 was in almost every respect a record year for the country's tobacco trade. The progress made by Empire growers in the United Kingdom market should give them satisfaction. The use of Empire leaf for home consumption last year was considerably larger than ever before, both quantitatively and as a percentage of the total consumption. The position of Empire tobacco was well maintained in the first quarter of 1938.

Short articles include a description of the effect of the Agricultural Adjustment Act on the United States tobacco industry and the adoption of auction sales for the disposal of tobacco in Nyasaland.

A specimen copy of *Tobacco Intelligence* may be obtained gratis by producers, merchants and manufacturers on application to the Imperial Economic Committee, 2, Queen Anne's Gate Buildings, London, S.W.1.

Soil vs. Nematode.—The Editor thanks Captain J. M. Moubray, of Chipoli, Shamva, for the following interesting letter:—

"Our soil knowledge has increased to such an extent during the last few years as to show certain routine we have always followed to be quite wrong. One example is the burning of tobacco seed-beds. To destroy the humus and bacteria in the top two or three inches of soil is not only to rob it of its very life blood, but to render the seedling far more susceptible to disease. The soil is then heavily dressed with chemical manures and the seedling expected to develop in a healthy manner in this unnatural medium.

C. R. Clarke, lecturer in Soil Science at Oxford, states:—The idea that a simple chemical analysis of a "dead" soil would serve the problem of economical fertilisation and cultivation is now fortunately nearly extinct. In its place is growing the conception of the soil as a living substance, almost an entity.

The conclusion arrived at by the Anthroposophical Agricultural Foundation is that the attempts of the last forty years to short circuit Nature by the use of artificial manures has failed. This opinion is being endorsed by the leading agricultural thinkers throughout the world.

The continual use of mineral fertilisers now that the stored up fertility of many years has gone is making the land sick, and not only that but it is rendering the crops grown on it susceptible to all kinds of diseases which under natural conditions they were able to resist. Sir Albert Howard, discussing green manuring to which compost has been added before ploughing under gives it as his opinion that if this is carried out for a few years on the potato lands of Lincolnshire "I am convinced we shall hear very little about the eelworm disease of the potato, the true cause of which, I suspect, is bound up with too much NPK."

On farms in England where compost is taking the place of artificials plant diseases of different kinds are disappearing in a most extraordinary manner. In some cases where many pounds used to be spent annually on sprays and poisons these are not now required.

It is a common sight in Covent Garden to-day to see stalls which sell produce grown on compost manured soils completely sold out, although the price charged has been higher than on adjoining stands whose produce has not all been sold, such produce having been raised on soils manured with artificials. I think, nothing could be more conclusive than this.

The problem in this country with tobacco as with maize and all other crops is to keep our soil alive, and this can only be done by the addition of humus in adequate quantities. The amount of farmyard manure produced on the average farm

is far too small to do this, and the only alternative supply is compost. A possible combination of the two may prove to be the solution in many cases.

I have used the same ground for my tobacco beds for many years, the area is large enough to provide for three times the number of beds required each year, so that the ground gets a rest for two years out of three. As soon as the plants have been moved a crop of sunnhemp or other bulk producing plant is sown, which is ploughed in together with the heavy weed crop on the remainder of the area. I would as soon think of manuring the land with scrap tobacco infested with spot and wildfire as of burning this ground. The beds are watered from a stagnant pool which is the result of seepage from irrigated citrus groves.

Nematode appears to be present in the root system of most of our citrus trees, but as long as the ground is well supplied with humus it appears to do little or no harm. I have grown heavy yielding crops of tobacco on land that was under citrus the previous season, and although there must have been nematode present, as many of the old citrus roots were sprouting and so alive, no sign of eelworm appeared on the tobacco. This was probably due to the live state of the soil which had received heavy applications of humus for some years previously.

I profess no technical knowledge on the subject, but like Sir Albert Howard, I am inclined to attribute the increase in nematode infection throughout the country to growing tobacco on a dying soil. Bring back the soil to a healthy living state by the application of compost and organics and give it a rest from chemical and mineral manures and it is probable that eelworm will gradually lessen and eventually become as negligible as on virgin soils.'

Crossing a donga by means of a four inch pipe.

A general view of the syphon with the outlet in the top background.

A Small Brick Irrigation Furrow

By H. W. H. Wallis, Assistant Irrigation Engineer.

Losses by leakage and absorption in small furrows when only a limited quantity of water is available at the draw-off point in a stream, are sometimes so great that a leading stream cannot be maintained, and frequently it is not even possible to obtain any water at all at the lower end of a furrow a few hundred yards long if the soil is very absorbent.

A brief description of a small furrow on "The Forest" farm near Penhalonga constructed by Mr. P. G. Deedes, with details of costs incurred, shows how full use can be made of a very small stream flow without the use of an expensive pipe line.

The volume of water available in the stream during recent dry seasons varies between 3,000 gallons per hour and 1,000 gallons per hour, equivalent to a range of 0.13 to 0.04 cusec. The latter figure corresponds to the discharge of a 2-inch pipe running just full with a low head, and a small flow of this nature is often described as useless for irrigation purposes if the land is any distance away, but by means of a brick furrow and a storage reservoir near the land, it should be possible to irrigate four acres with the lesser of the above figures and about thirteen acres with the greater.

The furrow constructed by Mr. Deedes is 6 inches wide and can take 4½ inches depth when full, and this, on a grade of 1 in 600 gives a capacity of 0.16 cusec. The bed consists of bricks laid flat side by side transversely, and bricks on edge longitudinally overlap the bed each side by 1½ inches, forming the side. The average number of bricks per linear yard of furrow is 14, including the joints, which is equivalent to 25,000 bricks per mile. Cement mortar was used throughout, about five pockets per hundred yards being required. This was done to lesson the chances of grass and weeds growing between the bricks and opening up the joints.

An interesting feature of the scheme is a 4 inch pipe siphon across a deep stream course, which replaced a pipe flume supported on wooden poles. Details of this are illustrated in the accompanying photographs. Short brick pillars were built to support the pipes and form joints for unscrewed pipes, and provision was made at the lowest point for a scour box with a detachable metal plate to discharge silt and debris as occasion demands. The siphon is 90 feet in length with 12 inches of fall between the inlet and outlet ends.

Storm water is passed over the furrow at intervals by bricking over the top, with bricks laid in a similar way to those forming the bed.

The following is a schedule of costs actually incurred on the 600 yards of furrow built to date, the labour part of which includes the work of building the siphon and a small weir across the stream at the intake:—

		£	s.	d.
	9,000 bricks @ 10/- per 1,000...	£4	10	0
	36 pockets of cement @ 5/-	9	0	0
	6 wagon loads of sand @ 5/-	1	10	0
Labour	1 native mason (2 months) @ £7 10/-	15	0	0
	4 labourers @ 10/- (2 months)	4	0	0
	Food for above labour	1	5	0
		£35	5	0

Mr. Deedes writes:—

"The figure is on the high side owing to the fact that the best materials were used and all cement instead of lime; the cost of the native mason could be reduced, but it suited me to have someone reliable whom I could leave to carry out instructions without further supervision."

After completion the furrow was lined throughout with cement mortar to prevent absorption, about 2½ pockets of cement being used per hundred yards.

When the full length of furrow has been completed a reservoir will be dug near the land to store the night flow and

the collected water will then be rushed out in a good stream for irrigating.

It is interesting to note that had $1\frac{1}{2}$ inch piping been used the cost at present rates would have been about £150 compared with the actual cost of about £35, and for the purpose required the brick furrow is just as serviceable.

Small gates were installed at various points to lead water to orchards, etc., the dipping tank is filled en route when required, and drinking troughs for cattle can be kept at a constant level by a simple ball valve control. The 600 yards built to date took two months and is a very creditable piece of work.

Mycological Notes.

SEASONAL NOTES ON TOBACCO DISEASES.

II.—TWO DESTRUCTIVE CURING MOULDS.

By J. C. F. HOPKINS, D.Sc. (Lond.), A.I.C.T.A.,
Senior Plant Pathologist.

Two moulds, which make their appearance from time to time in the barns during curing, have been fairly prevalent this season. They are associated with insufficient aeration and excess humidity and may cause considerable financial loss to growers. They are:—

BARN ROT.

This disease begins with a softening of the midrib of the leaf at the butt-end after colouring, and later a furry growth of white or greyish fungus makes its appearance. The butts soon turn dark brown and the discoloration extends downwards into the web of the leaf. The leaf tissues become wet and soggy and a grey mouldy growth of the fungus extends all over the infected area. The disease progresses very rapidly and in extreme cases may cause the hands to break away from the sticks and fall to the floor.

The mould is liable to spread in losely packed bulks, especially if they are put down in high condition, but the fungus does not appear to be able to develop actively in bales. The presence of barn rot in the latter does, however, affect the saleable value, as a certain mouldy flavour is imparted to the tobacco.

Cause.—Barn rot is caused by the fungus *Rhizopus arrhizus* Fischer, which develops on partly cured leaf maintained in an atmosphere deficient in ventilation and high in humidity. These conditions are brought about by excessively

Fig. 2.—Barn rot of tobacco. Herbarium specimen.

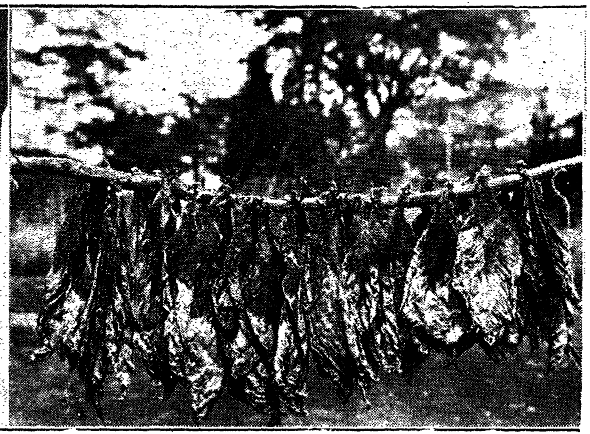


Fig. 3.—A stick of cured tobacco badly affected by barn rot.

close packing in the barns, which prevents air circulation. Suitable conditions for barn rot do not appear to be caused by high humidity and lack of ventilation alone, which would result from the addition of too much water and closing of ventilators. Close packing of the tobacco seems to be a necessary factor.

YELLOW MOULD.

This disease is not of frequent occurrence in Rhodesia, but may cause appreciable damage during curing under conditions similar to those which favour barn rot. It is not uncommon to find both diseases present on the same leaf.

Yellow mould first appears as small, medium brown, circular spots scattered over the leaf after the colour has been fixed. It is not unlike the incipient stages of frog eye or *Alternaria* barn spots. The spots increase in size, without changing colour, to reach a diameter of half an inch or less, but sometimes several spots may run together to form larger discoloured areas.

Cause.—This disease may be recognised, when the leaf is removed from the barn, by the presence in the centres of many of the spots of small circular patches of yellow fungus, which resemble pinches of powdered sulphur.

These minute tufts are the spore heads of the fungus *Aspergillus flavus* Link, which grows in the leaf tissues under the damp and close conditions of an overpacked barn, and causes the brown spots described above.

The same fungus has also been recorded on fire-cured tobacco in Rhodesia and has been observed to develop fairly freely in loosely packed bulks, spoiling the appearance of the leaf.

It is believed that this is the first record of *Aspergillus flavus* causing a leaf spot of tobacco, but how far it affects the flavour of the manufactured product is not known. Its chief importance at the moment lies in its ability to cause an unsightly spot which materially lowers the value of the leaf.

CONTROL.

The prevention of these diseases obviously depends upon correct packing of barns.

When climatic conditions cause large acreages of tobacco to ripen at one time, the amount of leaf to be cured is often in excess of normal barn accommodation. In an endeavour to obtain as high a yield as possible, it is only natural for the grower to pack as much leaf as possible into the available barn space, but such procedure may have disastrous results if barn rot and yellow mould become active.

In order to prevent heavy losses from these diseases, two alternatives present themselves. Either the leaf must be sorted during reaping and only the best retained for curing, or else priming must be so arranged that the total number of reaped leaves is reduced to suit barn accommodation.

The latter method is obviously preferable, for if priming is carried out at the correct times and the thin, papery leaves from the bottom of the plant are removed, then not only is the remaining crop improved in quality, but frog eye spotting is also eliminated.

Whenever a difficult planting season makes congestion in the barns inevitable at harvest, growers would be advised to plan their priming operations as far as possible to conform with the situation, bearing in mind that drastic early priming (such as is sometimes necessary for the control of angular spot) may delay ripening by a week or ten days.

Research Work at Government Experiment Station,

RHODES MATOPO ESTATE.

By C. A. Murray, M.Sc., Officer in Charge.

ANIMAL HUSBANDRY.

A. Nutrition.

Several experiments dealing with the effect of winter supplements on young growing stock have been completed.

Briefly, it may be said that the results so far indicate that the pastures at this Institution:—

(a) Contain sufficient minerals for maintenance and growth of ranch cattle.

(b) Are extremely deficient in protein during the dry period of the year and probably also in energy during the last month or two. During the past year the following nutrition experiments were either completed, in progress or commenced:—

(1) M.S.A. Project No. 39.—The Feeding of Supplements to Young Growing Steers during the 1st, 2nd or 3rd Winters after Weaning and the effect of the Supplement at these different stages on their subsequent development.

Object.—In a previous experiment (E23) it was found that the feeding of a protein supplement (peanut cake) to young steers during their first winter after weaning had little effect on their subsequent development, unless the feeding was repeated during the second or third winter.

This experiment was planned with the idea of confirming the above conclusion and getting more information on this particular question.

GROUPS I.—Veld grazing only (control).
II.—Protein supplement 2nd winter only.
III.—Protein supplement 1st and 2nd winters.
VI.—Protein supplement 1st winter only.
V.—Protein supplement 3rd winter only.
VI.—Protein supplement 1st, 2nd and 3rd winters.

Results.—The experiment has run for a period of two years only and it will take another 18 months to conclude. So far the indications are that our previous conclusion will be confirmed. In addition it appears, although it is too early to say definitely, that feeding during the second winter is more important than feeding during the first winter after weaning—from a growth and weight point of view. This raises some interesting points.

(2) M.S.A. Project No. 40.—Protein and Energy Deficiency Studies in Pastures.

Object.—Previous experiments (Nos. 6, 14, 23 and 28) have shown conclusively that the major deficiency in our winter pastures is one of protein and that 1 to 1½ lbs. of peanut cake met this deficiency. There were indications, however, that during the few driest months there may also be an energy deficiency.

The object of this experiment was to get information on the minimum protein requirements of young growing cattle under our conditions and also to find out to what extent there was a deficiency of energy, if any.

GROUPS—

	1st half of Winter.	*2nd half of Winter.*
I.	—Control—Veld grazing only.	
II.	—1 lb. maize meal.	1½ lb. maize meal.
III.	—½ lb. maize meal + ½ lb. peanut meal.	1 lb. maize meal + ½ lb. peanut meal.
IV.	—1 lb. peanut meal.	1 lb. peanut meal + ½ lb. maize meal.
V.	—1 lb. peanut meal.	1½ lbs. peanut meal.

Results.—The experiment will not be completed before the end of June, 1939, but so far it appears that: (*a*) During the *first winter* after weaning 1 to 1½ lbs. of maize meal is of very little use as a supplement for young steers. The animals did practically no better than those that received no supplement. Substituting ½ lb. of maize meal by ½ lb. of peanut cake improved the ration very considerably—as a matter of fact the animals did just about as well as those that received 1 to 1½ lbs. of peanut cake only. (*b*) During the *second winter* after weaning the maize meal fed animals did better than during the first winter, and those that had ½ lb. maize meal replaced by ½ lb. of peanut cake did as well as those that received peanut cake only.

These results, if confirmed by work which has already been commenced, will be of great economic value, as it will permit the use of more maize and less purchased peanut cake or other protein supplements for the wintering of young stock.

(3) M.S.A. Project No. 48.—Peanut Meal and Maize Meal for Wintering Young Stock.

Object.—To confirm or otherwise the results being obtained in Project No. 40 outlined above.

GROUPS—

I.—Control—Veld grazing only.
II.— 1 to 1½ lbs. maize meal each per day.
III.— 1 to 1½ lbs. peanut meal each per day.

Results.—This experiment has been in progress for only one winter and the results to date confirm those obtained in Project No. 40.

(4) M.S.A. Project No. 42.—Feeding of Na, Cl, and Fe. *Supplements to Young Growing Stock.

Object.—Previous experiments have shown that our pastures here are not deficient in Na, Cl, P and Ca. On the advice of the Division of Chemistry some farmers had, however, commenced feeding salt and iron to their stock and it was considered advisable to get some definite information as to whether this was necessary or not. Our experience here in the past has been that there was no deficiency of these minerals in our pastures.

*Na = Sodium. Cl. = Chlorine. Fe = Iron. P = Phosphorus. Ca = Calcium.

GROUPS—

I.—Control—Veld grazing only.

II.— Veld grazing + 1 oz. salt (Na, Cl.) daily.

*III.— Veld grazing + $1\frac{1}{4}$ oz. salt and Fe. daily.

Results.—The experiment has now been in progress for two years and there is to date not the slightest indication in regard to growth, condition or health that the animals have derived any benefit from the feeding of salt and/or iron supplements.

(5) M.S.A. Project No. 43.—Feeding of Na, Cl. and Fe. Supplements to Lactating Cows.

Object.—This was a preliminary experiment to determine whether lactating ranch cows would benefit if supplied with the salt and iron lick recommended by the Division of Chemistry.

GROUPS—

I.—Control—Veld grazing only.

II.— Veld grazing plus free access to a salt and iron lick consisting of: 100 lbs. salt, 25 lbs. oxide of iron and 1 lb. copper sulphate.

Results.—This experiment was run during the winter of 1936 and early summer of 1937 for a period of seven months only.

At the end of this period there was no difference in weight, condition or health between the two groups of cows or calves. It is proposed to do more extensive work during the coming winter to confirm these results.

(6) M.S.A. Project No. 21.—The Feeding of Phosphorus, Sodium and Chlorine Supplements to Ranching Cows.

Object.—To determine whether our pastures supply a sufficiency of these minerals for pregnancy and lactation in ranch cows.

*The salt and iron mixture fed is the same as the one used in Florida and recommended here by the Chief Chemist. It consits of 100 lbs. salt, 25 lbs. oxide of iron, 1 lb. copper sulphate.

GROUPS—

I.—Control—Veld grazing only.

II.— Veld grazing + $2\frac{1}{2}$ ozs. bone meal each per day.

III.— Veld grazing + $2\frac{1}{2}$ ozs. bone meal + 2 oz. salt each per day.

Results.—The experiment has been running for a period of three and one half years and to date the feeding of the supplements to Groups II. and III. does not appear to have benefited the animals or their progeny in any direction, and we conclude definitely that our pastures supply a sufficiency of these minerals for pregnancy and lactation in ranch cows.

(7) M.S.A. Project No. 47.—Protein, Energy and Mineral Supplements for Sheep.

Object.—To determine to what extent the results obtained by feeding different supplements to cattle are applicable to Blackhead Persian sheep.

GROUPS—

I.—Control—Veld grazing only.

II.—Veld grazing plus 3 ozs. peanut meal each during winter months.

III.—Veld grazing plus 3 ozs. maize meal each during winter months.

IV.—Veld grazing plus 3 ozs. per week each of mixture of 75 bone meal and 35 salt.

V.—Veld grazing plus 3 ozs. per week each of 75 bone meal, 40 salt and Fe lick.

Results.—The experiment has now run for a period of 18 months and at no time have there been any differences in weight, condition or health between the different groups. From this it appears that granted the animals are free of internal parasites it is not necessary to feed either energy or protein or mineral (Ca, P, Na, Cl., Fe) supplements to mature Blackhead Persian sheep on our set soil pastures.

B. Steer Fattening.

(8) M.S.A. Project No. 36A.—A Comparison of Cowpea Hay and Sunnhemp Hay for Fattening Steers.

Object.—Sunnhemp is grown fairly extensively in different parts of the Colony, and as no definite information was available as to its feeding value the present experiment was carried out.

Groups—

Average Daily Ration per Steer.		I.	II.
Cowpea Hay...	lbs.	6.6	—
Sunnhemp Hay...	lbs.	—	6.6
Maize Meal...	lbs.	12.6	12.6
Veld Hay	lbs.	14	12

Results.—Published in *Rhodesia Agricultural Journal*, Vol. XXXV., No. 1, January, 1938, by A. E. Romyn and R. H. Fitt.

"Sunnhemp hay (Somerset variety) when cut in the early bud stage and properly cured is as palatable and valuable a feed as New Era cowpea hay in a standard ration in this Colony for fattening bullocks."

(9) M.S.A. Project No. 49.—Peanut Meal v. Cotton Seed Meal v. Meat Meal as x Protein Supplements for Fattening Steers.

Object.—To determine to what extent these three feeds are interchangeable as protein supplements for fattening steers.

Groups—

I.	II.	III.
Veld Hay.	Veld Hay.	Veld Hay.
Silage.	Silage.	Silage.
Maize Meal.	Maize Meal.	Maize Meal.
Peanut Cake.	Cotton Seed.	Meat Meal.

Results.—Published as Bulletin No. 1062, March, 1938.

(10) M.S.A. Project No. 41.—Baby Beef Experiment.

Object.—To get information on the practical and economic aspects of feeding young steers to be ready for export as chillers at $1\frac{1}{2}$, $2\frac{1}{2}$ and $3\frac{1}{2}$ years of age.

GROUPS—

I. Cows and Calves.—Both fed before weaning and calves exported at 18 months of age.

II. Calves not fed before weaning but wintered well and exported at $2\frac{1}{2}$ years of age.

III. Calves fed winter maintenance rations only and exported at $3\frac{1}{2}$ years of age.

Results.— Experiment completed but data not yet worked up.

AGRONOMY.

During the year close on 800 plots were under different crops and treatments. The different experiments dealt with:—

(*a*) Maize variety trials.

(*b*) Different crops for grain.

(*c*) Different crops for ensilage.

(*d*) Maize spacing for grain and silage.

(*e*) Sunflower spacing for grain and silage.

(*f*) Cowpea spacing for upright and trailing varieties for hay.

(*g*) Quantitative superphosphate trial.

(*h*) Different fertiliser treatments.

(*i*) Rotation trials.

(*j*) Different crops cut for hay and ploughed in for green manuring.

From a crop experiment point of view the season was the worst we have ever had. On the sand veld good results were obtained, but on the black soil the plots were re-planted three times, and even after that the stand was so poor on some ranges that the results had to be discarded. Fortunately this was not the case on the green manuring and rotation ranges or the sand veld. Due to my absence overseas, however, the data have not yet been worked up statistically and results are, therefore, not available for inclusion in this report.

The crop experiments have now been in progress for a period of four years, and although we as yet are only in a position to give farmers tentative advice, the work is already proving of great value to the farming community at this end of the country.

Annual Report of the Agriculturist

FOR THE YEAR ENDING 31st DECEMBER, 1937.

By D. E. McLoughlin, Agriculturist.

SEASON AND CROPS.

The season opened with great promise and the early rains in November and December provided ideal planting conditions and a good germination. A dry spell of three weeks was experienced from the middle of December to the second week in January. On the whole the growing season was favourable to the maize crop up to the end of February. The copious rains which fell in February were required to see the maize crop through, as the rainfall in March was negligible and arrived too late to exercise any beneficial effect on crops.

Maize.—Owing to the early cessation of the rains the grading of the crop for export commenced fully a month earlier than in the previous year. The 1936-37 European crop was another record one and the largest Southern Rhodesia has yet attained. The total maize acreage planted was 277,612 acres as compared with 266,513 in 1935-36. The total production was 2,039,341 bags or 7.35 bags per acre as against 1,985,848 bags or 7.45 bags per acre, in the previous record year, 1935-36.

The Mazoe district produced 674,292 bags or 8.9 bags as against 9.2 bags per acre in 1935-36; Salisbury 449,660 bags or 8.8 bags as against 8.7 bags; Lomagundi 238,589 bags or 7.2 bags as against 8 bags, and Hartley 230,901 bags or 8.3 bags as against 8.6 bags per acre in the previous year.

The production in Matabeleland was 224,321 bags from 48,955 acres or 4.6 bags per acre.

Ground Nuts.—The acreage planted to ground nuts was 5,140 acres, which is 382 acres less than in the previous year. The production was 45,981 bags or 9.9 bags of 65 lbs. each per acre.

Green Manuring.—The acreage planted to green manure crops, *viz.*, 51,536 acres, is only 2,459 acres less than in 1935-36. Sunnhemp remains the most popular green crop, followed by sunflower. It is pleasing to record that 3,801 acres were planted to trap crops for witchweed, which is a substantial increase on last year's acreage.

Wheat.—The season was an unfavourable one and the crop suffered from lack of moisture and damage by frost. The total crop was 49,935 bags of 200 lbs. as follows:—

Irrigated.—5,667 acres, yield 27,030 bags, or 4.8 bags per acre.

Not Irrigated.—16,279 acres, yield 22,905 bags, or 1.4 bags per acre.

Maize Grading and Export.—The commencement of the shipping of the crop from Beira was delayed by a shortage of trucks, but the whole crop was moved rapidly eventually, before the seasonal rains commenced.

Weevil.—Towards the end of July weevil made their appearance at various sidings where they had never previously been found so early in the season. This unusual occurrence was investigated by the Division of Entomology and a report on the matter was published by Mr. M. C. Mossop in the December issue of the *Rhodesia Agricultural Journal.*

Staff.—Mr. L. C. Roberts again acted as Senior Grain Inspector and Mr. C. Keppie as a Temporary Grain Inspector. Messrs. C. Blofield and J. J. Erasmus were employed for the first time as Temporary Grain Inspectors.

Remarks.—There has been a remarkable increase in the quantity of native-grown maize graded from a total of 54,000 bags last year to a total of 257,158 bags this year. The quality has also improved greatly, since the percentage of

No. 2 grade last year was nil, and this year has been a total of 18 per cent., or a total of 46,695 bags.

Maize was graded at the following points for the first time:—Marabada, Odzi, Umtali and Umsweswe. At Odzi very inadequate accommodation for maize exists.

Owing to the delay in commencing to rail maize to Beira, a considerable quantity of maize remained at the grading points after grading for as long as two months, and late deliveries had much difficulty in finding space for stacking. Naturally, too, a good deal of maize graded when free from weevil became slightly weevily before railing. Owing to the early cessation of the main rains, the maize was exceptionally dry, as is shown by the fact that only five moisture tests were carried out by graders in the field, and only 12 at headquarters. As a contrast it may be mentioned that nearly 300 moisture tests were made in the previous season.

The statistics of the maize graded during the year are as follows. The native grown maize is shown separately from that grown by European farmers:—

A.—Maize Graded by Grading Staff.

1. *European Grown.*

Grades	2	3	8	Rejects.	Totals.
	714,454	17,474	—	2,232	
Percentages of total ...	97.3%	2.4%	—	0.3%	734,160 bags.

2. *Native Grown.*

	46,695	187,391	19,201	3,871	257,158 bags.
Percentages of total ...	18.0%	73.0%	7.5%	1.5%	

B.—Maize Graded by Maize Control Board.

Grades	2	3	8	Rejects.	Totals.
	420,484	52,567	19,025	—	492,076 bags.
Grand total of maize graded					1,483,394 bags.

The quantity of maize exported from the Colony during the year is shown below. These figures are supplied by the Rhodesia Railways:—

via Beira, January to June	=(1935-36 crop)	365,162 bags
via Beira, July to December	=(1936-37 crop)	1,133,319 bags
Total		1,498,481 bags
To Bechuanaland		300 bags
Grand total		1,498,781 bags

Bulawayo.—No maize or maize meal was graded at, or exported from, Bulawayo during the year.

The revenue derived from maize grading fees amounted to over £2,000.

Winter Pasture Grass Trials, Melsetter.—Several farms in the Melsetter area are carrying out trials with winter grasses and legumes in co-operation with this Department.

On the test plots of Dr. Rose and Mr. Olivey, the following grasses and New Zealand White Clover showed good promise:—Red Top, Brown Top, Yorkshire Fog, Cocksfoot, New Zealand Tall Fexcue; Sheep's Burnet also established well, and at Chipinga it demonstrated extraordinary drought resistance on Mr. Gilbank's farm. Mr. Hanmer, however, reports that Burnet, which was sown on his farm some four or five years ago, has now died out; but the Yorkshire Fog established at the same time is still flourishing. New Zealand White Clover was established well, but requires phosphate. Lotus major was also established, but had made little growth in July. In none of these trials was any fertiliser applied, but arrangements have been made with Dr. Rose and Mr. Olivey to apply 100 lbs. per acre of double superphosphate.

Mr. Sinclair, who is managing a large sheep farm near Melsetter, has made independent trials or winter grasses and White Clover, and these were inspected by the Assistant Agriculturist when he toured the Melsetter District in July.

The virgin soil (grey-brown, sandy-loam) was only half ploughed and no real seed-bed prepared and no fertiliser applied. Nevertheless, he had most encouraging results from sowings of Dutch White Clover, Cocksfoot and Red Top, and this season he is extending trials considerably, and preparing a proper seed-bed, and applying 100 lbs. per acre of mono-phosphate of ammonia. Acting on advice, he has obtained seed of New Zealand White Clover and various additional grasses for trial.

Samples of soil from the grass plots on Sawerombi, Lemon Kop, and Mr. Sinclair's plots were taken and tested for reaction, and in no case was the PH value lower than 6.6. A dressing of lime of half to one ton per acre should therefore suffice for the growing of lucerne and clovers.

Mr. Hanmer is sowing several acres of Rhodes grass this season and Mr. Sinclair is sowing two acres of Kafue Rhodes grass with seed supplied by this Department.

Rhodes grass flourished on Mr. Gilbank's farm at Chipinga, and yielded a heavy crop of hay. Woolly Finger grass, Swamp Couch and Reed Timothy have also been established on Lemon Kop and on Mr. Gilbank's farm, with roots supplied by this Department.

Royal Cape grass has been supplied to the Melsetter Golf Club for planting on their fairways, and this will be watched with a view to its being of possible value as a winter sheep pasture owing to its resistance to frost.

Dry Land Pasture Grass Investigations.—Investigations regarding the stock carrying capacity on normal, red, maize soil and a number of the most promising grasses which have been established as pure stands in small paddocks were continued.

The tabulation given below shows the number of ox-grazing days obtained from the various paddocks since the commencement of these trials in 1931-32.

The droughty conditions which prevailed during part of December and January, coupled with the low rainfall during March, reduced the yield of pasturage obtained from the grazing paddocks very considerably.

YIELDS IN OX-GRAZING-DAYS PER ACRE.

Season.	Woolly-Finger grass.	Hunyani grass.	Creeping False Paspalum.	Reed Timothy.	Mixed Creeping grasses.
1931-32	316	307	—	—	—
1932-33	192	198	204	319	—
1933-34	238	238	385	243	251
1934-35	319	216	180	319	354
1935-36	194	197	243	248	134
1936-37	162	162	213	190	142

These returns show that the Wooly Finger and Hunyani grass pastures are now less productive than they were during the first few years following their establishment, but nevertheless they still have a carrying capacity which is much greater than that of the unimproved veld. The Creeping False Paspalum is still giving satisfactory returns, but the Reed Timothy appears to have suffered from the summer drought and it is now less virile than the creeping grasses which were planted with it.

Several new Digitaria varieties have been introduced by the courtesy of the Division of Plant Industry of the Union of South Africa, and trials to determine the relative value of Rhodes grass, Kafue Rhodes and Hunyani grass have been commenced.

During the month of March Mr. H. C. Arnold visited the Union of South Africa for the purpose of inspecting the work being done by the Division of Plant Industry in connection with pasture reclamation and improvement. Pretoria, Potchefstroom, the plant breeding station at Prinshof and the experiment stations at Rictondale, Warmbaths and Rust-der-Winter were visited. Much very useful information was gathered and propagating material of several of the most promising species of grass were obtained for trial in this Colony. These have been carefully tended, and have increased sufficiently for small issues to be made to other centres.

Pyrethrum.—Promising results have been obtained with the progeny of plants selected for their high yields of flowers. Whereas among the original stock, under dryland conditions only about 25 per cent. of the plants produced flowers, the number of flowering plants has been raised to 75 per cent. more in our best selected strains on dryland and to 90 per cent. under irrigation. The yield of dried flowers obtained from these new strains when they are grown under irrigation has reached fully 450 lbs. per acre, and it is thought that if a market could be established this crop would be found to yield profitable returns on irrigated land.

Pelargonium.—Experiments with this crop have continued over three years. Sufficient material to establish about a quarter of an acre has been obtained. Hitherto much difficulty has been experienced in getting the cuttings to form roots, and it has been found that the best results are obtained when cuttings 12 to 15 inches long with numerous internodes and including the terminal shoots, are employed, and the lower half of each cutting is embedded in clean sand. These must be protected from the heat of the sun and withering effects of the drying winds for a few weeks. Even though the plants may have been satisfactorily rooted in nursery beds, a number of them may succumb when they are transplanted to the open lands. This crop is therefore by no means an easy one to establish. Green material taken from plants established during December, 1936, was analysed by the Division of Chemistry during June, 1937. It was found to contain .2 per cent. of essential oils. This represents a yield of approximately 26 lbs. of oil per acre and is about equal to the yields obtained in Kenya Colony.

AGRICULTURAL EXPERIMENT STATION, SALISBURY.

The year 1936-37 season opened with very favourable climatic conditions, and the early sown crops made good progress at first, but droughty conditions prevailed from mid-December to mid-January and the lack of rain caused a serious

set-back both to the annual crops and the "permanent" pastures alike. Crops sown between the 15th December and 15th January produced very poor stands and the yields suffered in consequence. Copious rains fell in February and March and these partially relieved the damage caused by the drought during the earlier part of the season, but on the whole the crop yields were considerably lower than those of the previous season.

The activities of the Station were mainly concerned with the continuance of the experimental work which was in progress during the previous season, a detailed report of which was published in the July issue of the *Rhodesia Agricultural Journal*.

The work of this Station has been increased through the greater replication of the treatments undergoing investigation and the number of plots for the season 1937-38 is 3,422, which is approximately 600 more than last season.

Issues of seeds and other planting material were as follows:—

Free issues of seeds to farmers in this Colony ...	198
Free issues of grass roots and kudzu in this Colony	261
Free issues to Experiment Stations within Colony	68
Exchange issues to foreign Experiment Stations	80
Cash issues	51
New introductions of planting material	82

Valuable results were obtained from the investigations into the effect of the climatic conditions subsequent to ploughing under green manure on the maize crop which follows. It was shown that where the green manure crop had been ploughed under early in the season, the beneficial effect on the maize crop which was followed was very considerably less than it was on those plots on which the ploughing under of the green manure was delayed for a few weeks. It appears that

in practice the most suitable period for ploughing under the green manure crop lies between the middle of March and the middle of April. Another series of experiments indicated that heavier seedings of the sunnhemp green manure crop than those usually employed, gave considerably increased yields of maize.

The following extracts are quoted from Mr. Arnold's report:—

"The feeding value of our most popular fodder crops, such as maize and wintersome, is below the standard required by quick-growing and/or high producing farm animals, because of the high proportion of carbohydrates and fibre which they contain as compared with their low protein content. Investigations to ascertain the relative ability of these and our most important legumes to produce protein suitable for consumption by farm animals have been conducted during the past two years. These indicate that although the leguminous crops only yield half as much material per acre, they yield twice as much protein per acre as the cereals, because their protein content is approximately four times as great as that of the maize and similar crops. When it is remembered that the legumes remove a smaller amount of plant food from the soil, and moreover, the residues they leave actually benefit the following crop, it will be seen that farmers would be well advised to grow as large an acreage of legumes as they can utilise for farm stock feeding. In our trials, velvet beans yielded larger amounts of protein per acre than either soya beans or sunnhemp.

A new variety of maize called "Southern Cross" has been under test for the past two seasons, and has produced higher yields than our standard varieties on both occasions. In 1936 its yield exceeded that of Hickory King by 297 lbs. per acre, acre, and in 1937 it yielded 414 lbs. per acre more than A.E.S. Salisbury White, and 111 lbs. per acre more than the Plant Breeding Station hybrid (the latter may not be statistically significant). The Plant Breeding Station hybrid was definitely more resistant to diplodia and gibberella than either Southern

Cross or Salisbury White. The number of diseased ears found among approximately 3,000 of each kind were:—Plant Breeding Station hybrid 272, Salisbury White 472, Southern Cross 421.

Crossed maize v. Ordinary stock. Seed was obtained by cross-pollinating plants whose parents had been selfed for three generations. When these were sown in alternate rows with ordinary open-pollinated maize, yields in favour of the crossed maize were obtained, amounting to an average of 1½ bags per acre.

Over 200 strains of hybrid soya beans were planted in replicated plots, the object being to secure strains which retain their seed long enough to enable the mature seed to be harvested without undue loss. It is thought that types which are more branched have finer stems and a larger proportion of leaves than the varieties at present in cultivation, will be found among these hybrids.

Upwards of 400 strains of hybrid velvet beans were sown with a view to the selection of those which, by maturing late in the season, will produce fodder which can be cured as hay during the dry autumn months and be comparatively free from the thick, fleshy pods which make the Somerset variety difficult to cure. These preliminary trials indicated that strains which produce very considerably heavier yields of vines and leaves than the Somerset variety will emerge from this work."

Wheat Experiments: Umvuma.—The variety trial and rate of seeding trial were continued on the farm of Mr. E. G. Raubenheimer, but the results of this year's work are not at present to hand.

In 1936, the average yield of all ten varieties on all plots was approximately eleven bags per acre, and the highest average yield of a single variety was 13.0 bags per acre.

In the rate of seeding trial the highest rate of seeding (80 lbs. per acre) again gave the highest mean yield per acre of 7.30 bags. The results to date are shown in the following tables:—

VARIETY TRIALS.

Variety.	1934.	1935.	1936.	Mean yield per acre in bags—over 3 years.
Punjab 8a	8.39	7.86	12.60	9.61
Lal Kasar Wali	7.32	7.94	12.70	9.32
Early Gluyas	8.48	7.48	10.98	8.98
Karachi...	6.43	5.62	13.00	8.35
Kenya Governor	8.29	6.25	10.48	8.34
Quality	6.55	6.25	11.69	8.16
Garnet...	8.85	6.22	9.17	8.08
Rhodesian Reward ...	7.36	5.29	8.36	7.00
58 F.L.I.	—	—	11.49	—
F.6.W.10...	—	4.91	9.78	7.34 (2 years)

RATE OF SEEDING TRIAL (KENYA GOVERNOR).

Rate of seeding per acre.	Average yield per acre in bags—two years.
40 lbs.	6.75
50 lbs.	7.05
60 lbs.	6.90
70 lbs.	7.20
80 lbs.	7.30

PLANT BREEDING STATION, HILLSIDE.

Mr. T. K. Sansom, the Plant Breeder, in his Report states that the season as a whole proved a favourable one for summer crops. A total of only 26.37 inches of rain was recorded, but the distribution was fairly good. The Salisbury White x Johnson's County White variety of maize bred by him returned an average of 12 bags per acre. This yield can be regarded as very satisfactory as the soil on this Station is a very poor granite sand. Breeding work with this new hybrid was continued. Seed was issued to farmers for trial to test its yielding capacity and resistance to diplodia under farming conditions. Tests were also conducted with this cross on the Salisbury Experiment Station and the results indicate that it is capable of returning yields equal to those of the standard

flat white varieties at present grown in the Colony. It again proved highly resistant to diplodia and the cross is now used as the variety on the Salisbury Experiment Station in the various experiments. Further single plant selections are being made for resistance to diplodia and increased yield.

Winter Crops.—Owing to the early cessation of the summer rains and the short rainfall, the moisture retaining vlei-land was very much drier than in previous years and the whole of the breeding plots had to be watered by hand from the 20th August to the middle of October. No water was applied to the fertiliser trial plots. Many of the plots in this trial suffered severely from lack of moisture.

Fertility of Plant Breeding Plots.—The practice of green-manuring in the summer with sunnhemp has proved very successful on the black granite vlei-soil on this Station as a means of increasing its humus content. The soil is now slightly alkaline. This condition was obtained by the application of 11,150 lbs. lime applied over a period of six years. A dressing of 10 tons of kraal manure, 1,500 lbs. lime, 200 lbs. of 20 per cent. superphosphate and 75 lbs. muriate of potash per acre were applied to all plots except the fertiliser trial plots.

Plant Breeding Work.—Rust infestation was very mild during the 1937 season. The quality of the grain was excellent, and of the sixty-nine samples analysed to date by the Division of Chemistry very few have a protein content of less than twelve per cent., calculated on the dry matter. Samples of Reward had a protein percentage of 19.90, which is the highest percentage so far obtained with the variety on the Station. During the previous two seasons, which experienced a much higher summer rainfall, the protein content of the wheats grown was very much lower. The high protein content of the wheats grown in 1937 is attributed to the lack of moisture and the early ripening of the crop.

Wheats which have shown promise in previous seasons have continued to do well.

Owing to the severity of rust attack during the previous winter, a large number of wheats were discarded. During the past season 128 varieties and selections were under trial.

Twenty-seven were new introductions from the United States of America, New Zealand, Argentine and the Union of South Africa. The wheats from the United States and Argentine have all been retained for further trial.

The wheats obtained from Kenya in 1934 have continued to show promise, and generally speaking have done well under local farming conditions.

During the past five years 362 wheats have been under trial; an average of five single plant selections have been made from each variety. Eighty-nine "rogues" and 123 selections from crosses have also been under trial. During the period 2,384 varieties and selections have been tested.

Small Scale Yield Trials.—These trials have been carried on for five years. The following wheats have consistently yielded well:—Kenya Governor, Quality, Reward, Droop 3, Cawnpore 13, and Lal Kasarwali. Punjab and Karachi have done well in seasons of mild rust attack. Several new varieties from Kenya, Canada, Argentine and Australia have shown great promise during the past season, but have only been under trial one year.

Rate of Seeding Trial.—The results of the third year of these trials generally confirm the results of the first and second year. Eight rates of seeding, rising by 10 lbs. per acre from 20 lbs. to 90 lbs. per acre, were employed. The second highest rate (80 lbs. per acre) gave the highest yield and there was generally a progressive increase in yield from the 20 lbs. per acre rate to the 80 lbs. rate. The results again indicate that the best rate of seeding lies between 60 and 80 lbs. per acre. The analysis of the protein content revealed only a slight difference between the different rates of seeding.

The bushel rate increased with the rate of seeding from 66.44 for the 20 lbs. rate up to 68.25 lbs. for the 90 lbs. rate.

Wheat Fertiliser Trials.—These have run for three years and the results obtained this season confirm in the main the previous two year's results. The beneficial effect of dressings of 1,000 lbs. and 2,000 lbs. of lime per acre when applied by itself, and also in combination with fertilisers and kraal manure, plus fertiliser, were again demonstrated. The

application of 1,000 lbs. of lime per acre in the third year exceeded the yield of the plots receiving 200 lbs. complete wheat fertiliser by $1\frac{1}{2}$ bags per acre, and equalled the yield given by a dressing of 8 tons of kraal manure. Lime alone gave a return of $2\frac{3}{4}$ bags per acre more than the control (no treatment). The highest yield was again returned with the dressing of lime plus kraal manure plus fertiliser.

The results again confirm the value of lime on granite vlei soils and the great advantage of an application of 1,000 lbs. per acre for three years or applications of 2,000 lbs. per acre applied at much longer intervals.

Distribution of Seed Wheat.—Several promising varieties have been bulked up for distribution to farmers. A brief description of the characteristics of the wheats available for distribution was published in the December issue of the *Rhodesia Agricultural Journal.*

Agricultural Shows.—Officers of the Agricultural Branch attended and judged at all the Shows held during the year, and Mr. T. K. Sansom, by invitation, also judged at the Kafue Show, in Northern Rhodesia.

Witchweed.—The opening of the 1936-37 season was very favourable to the germination of witchweed, and in consequence the parasite was much in evidence.

The variation in the favourability or otherwise of the seasonal conditions to the germination of witchweed is the cause of much confused deduction by farmers of the results obtained from their control work, particularly in connection with trap cropping, since a continuous wet spell during the two months growth of the trap reduces its efficiency. When this is followed by a season favouring the germination of the parasite the average farmer condemns the practice out of hand. This was the case in the two seasons 1934-35 and 1935-36, and it has lead to trapping as a means of control receiving a set-back. However, a number of farmers still make it their regular practice, and are whole-heartedly in favour of it.

Another factor militating against the extension of trap cropping is that when the infestation in the land trapped approaches the "saturation point," the farmer sees, after trapping, far more witchweed above ground than he has ever seen previously in that field, and the improved growth and yield of the maize crop is largely discounted in consequence, and the farmer finds it difficult, in view of the visual evidence, to believe that trapping must have reduced the amount of witchweed seed in the soil.

Despite these difficulties, however, the control of the parasite is now the regular routine on the great majority of farms in the maize belt, and it is considered that the record maize crops of the past two seasons are in no small measure due to a definite reduction in the amount of witchweed present on the cultivated lands. The reports by farmers on their own experiences in controlling the parasite which have been published in the *Rhodesia Agricultural Journal* during the year without exception show evidence in support of this statement, and a healthy note of optimism prevails through all of them.

The Assistant Agriculturist, Mr. S. D. Timson, in his report, comments on the following points of interest:—

Manurial Value of Trap Crops.—The experiment which has been in progress for the past three years at the Salisbury Experiment Station to investigate the manuarial value of one trap crop ploughed under in the season as compared with sunnhemp has been completed. The results indicate that one crop of Amber Cane or White Kaffir Corn, when ploughed under at two months from germination, is approximately equal in manurial value to a crop of sunnhemp as judged by the yields of two succeeding maize crops. The results of this experiment and of the one mentioned below are being published in the January issue of the *Rhodesia Agricultural Journal.*

Carbon-Nitrogen Ratio of Trap Crops.—With the co-operation of the Division of Chemistry an experiment was commenced, which is designed to investigate the age at which the various trap crops reach the widest carbon nitrogen ratio which will ensure that no available nitrogen from the soil will be immobolised when they are ploughed under.

The first season's results confirm the advice to farmers by this Division up to date, namely, that if traps are ploughed under within two months from germination no nitrogen starvation of the crop planted the following year will take place; but there is danger of this taking place if ploughing under is unduly delayed. It is remarkable that Rhodesian Sudan grass (*Sorghum arundinaceum*) did not reach the limiting carbon-nitrogen ratio (20:1) until approximately 3½ months from germination.

This is a further advantage which this grass possesses as a trap crop over the other trap crops commonly used.

Trap Crops: Varieties Recommended.—A further season's experience confirms the writer in his opinion that Rhodesian Sudan grass is clearly superior to all other trap crops so far tested in this country.

Triple Trap-Cropping.—With the kind co-operation of Mr. A. W. Laurie an experiment has been commenced, on his farm Howick Vale, at Concession, to investigate the feasibility or otherwise of growing three trap crops of Rhodesian Sudan grass in one season, and of killing them effectively by the use of the disc-harrow instead of the plough; and also to find out the maximum age of the crop at which the latter is possible.

Reports by Farmers on Witchweed Control.—A number of farmers were requested to give the results of their experience of controlling the parasite. Most of these replies were published during the year in the *Rhodesia Agricultural Journal*, and there is good reason to believe that they have materially assisted to convince the doubters that the methods of control recommended by this Division are sound and effective. It is particularly noteworthy that in every report it is clear that the writer has no doubt of his ability to control the parasite.

Spread of the Parasite by Cattle.—Mr. H. H. Farquhar's report on investigations into this matter which he carried out, was published in the July issue of the Journal. He throws new light on the part which may be played by cattle in spreading the parasite, and it appears likely that this agency is of much greater importance than his hitherto been thought.

He showed that cattle will eat the plant and that the seeds will pass through their bodies without, apparently, any ill effect on their germination.

It is not possible rightly to assess the importance of these facts until sufficient evidence is available as to the extent to which cattle actually eat witchweed when grazing, and whether they exhibit any partiality for it, or merely eat it by accident whilst grazing the surrounding grasses. This is necessary before it is possible to make clear cut recommendations with regard to the necessity or otherwise for vigorously eradicating it from the veld as well as from the cultivated land.

The Artificial Incubation, Brooding and Rearing of Chickens.

By H. G. Wheeldon, Poultry Officer.

Everyone engaged in poultry farming is confronted with the problem of raising young stock. The pivot point on which the success of the poultry farmer turns is his ability to renew the laying flock satisfactorily each year. The profitable period of a fowl's life is so short that it is necessary to raise stock for the laying pens every year, and the beginner finds this to be the most difficult part of the whole business, while success in this direction is most important. This is attained only by the intelligent application of correct methods. If the incubation, brooding and rearing of chickens are not carried out under such conditions as will produce and maintain both growth and good constitutional qualities the mature stock will fail to produce or earn more than a nominal profit. Any setback during the life of the chicks will adversely affect their stamina, and the progeny of such stock, if raised under similar conditions, will be less valuable than the parents. With such deterioration the flock would become unprofitable in two or three generations. On the other hand chicks from good stock, if given intelligent care and surrounded with the essentials required for proper growth and robust development, would mature into poultry capable of returning to their owner the last farthing in payment for the food and accommodation provided. Good methods, well grown and matured stock. increase the productive efficiency of succeeding generations, and the road to successful poultry farming is immediately opened.

The chick hatched for the market must make rapid growth; not so much of bone and muscle as of flesh and fat. To do this in the shortest time assures the greatest profit, and the conditions and methods of rearing in many cases must be

largely artificial. The chick destined for the laying house, however, must be allowed to grow steadily without any set-back, natural conditions must be approximated as closely as possible with a view to raising stock with a vigorous constitution. The young birds will then withstand the strain of heavy egg production, which is necessary to produce the results that count.

The building up of a strain of fowls involves something more important than breeding for standard points and prolific egg production, that is breeding for health and constitutional qualities. Those who are successful in the business on a large scale have learned by experience that it pays to breed for vigour and vitality. These qualities cannot be expected to be transmitted to the chicks if not inherent, whereas defects are often passed on to the offspring for several generations, with a tendency to increase rather than lessen.

The Breeding Stock.—Select the breeding stock first for health and vigour, then for desired qualities in other respects. Choose only the best for the breeding pens, even if a few birds only are used, and pen them with a view to off-setting physical defects by mating birds that are strong where the other show weakness. When the individual birds have been selected and properly penned according to ancestry, then house, manage and feed them sensibly with a view to maintaining health and profitable returns. Their requirements must be met and constant supervision is necessary. A comfortable shelter when needed from the rays of the sun and wet weather; a fair variety of wholesome food; clean drinking water; a *liberal supply of green food*, and suitably ventilated houses without draughts are important essentials.

It is not sufficient to exercise reasonable care with the breeding stock alone, the careful handling of the eggs before incubation, during incubation and the management of the chicks to maturity are of equal importance. It is upon the common sense application of the essential requirements that the success of commercial poultry production depends. Year after year complaints are heard of lowered vitality in the flocks; of the greater difficulty in obtaining a good percentage of fertile eggs; of poor hatches; of chicks dead in shell; and of chicks which did not thrive, though a fair percentage

hatched. This lack of stamina is often the result of in-breeding and impaired constitution, bad housing, incubation, rearing and feeding, without due consideration of the requirements for maximum results.

Assuming then that the breeding birds have been carefully selected, well housed and supplied with their normal requirements, the next point of importance is the proper care of the eggs for incubation; this is where many poultry farmers unconsciously go wrong. Careless methods of handling and storage of the eggs for incubation and during incubation impairs the hatchability. Probably more chicks are found dead in shell or are weakly after hatching as the result of wrong methods of handling than from any other cause.

Eggs for Hatching.—Eggs intended for the incubator should be gathered once daily in cool weather and twice during the hot weather. Renew the nesting material often, handle the eggs with clean hands, place them in a clean receptacle, and keep them in a rack with small end downward, or if they are stored on their side, turn the eggs daily. Avoid excessive evaporation of the contents of the eggs by covering them with a cloth. The room in which they are kept should be fresh and cool, a temperature of about 60° is desirable. Wherever possible they should be used for incubation before they are ten days old, as the germ weakens with age. Prolonged exposure of the eggs to a temperature of 80° or 90°, or frequent warming and cooling before incubation, may destroy the germ or will surely result in a weak chick. Select only the best eggs for incubation. Uniformity in size, shape and shell texture are important, and they should not be less than 2 oz. in weight.

Artificial Incubation.—Artificial incubation may account for considerable losses, because the hatchability of eggs is so easily affected by machines carelessly operated or handled without sufficient knowledge of the work. It should be mentioned that with the modern systems of incubation good results are invariably obtained if the machines are managed with due care. There are various types and makes of incubators, such as moisture or tank machines and those embodying the hot air principle, each of which gives satisfactory results. Mammoth coal burning machines are available, and cabinet incubators embodying similar principles more recently introduced are

heated either by blue flame lamps or electricity. It is necessary to understand thoroughly the operation and conditions most suitable for these incubators by following the printed instructions accompanying each machine.

In choosing an incubator be sure of obtaining one of sufficient capacity to meet requirements. It is much better during the initial stages to incubate fewer eggs in a machine with reasonable greater capacity than to have a surplus of good eggs for hatching with only a limited incubation capacity.

Incubation may be successfully carried out throughout the year, especially when ducklings and chickens are intended for table purposes. The most seasonable and profitable period for hatching chicks for renewal of the laying flocks is during May to August.

The most important points to consider in providing suitable conditions for incubation are freedom from excessive vibration with uniform temperature and adequate ventilation of the room. It is important that the incubator be level on a solid foundation or platform and the room suitably ventilated and controlled to provide a steady replacement of the atmosphere without excessive draughts. Strong currents of air may be controlled in windy weather by inserting hessian-covered frames in the open spaces provided for ventilation.

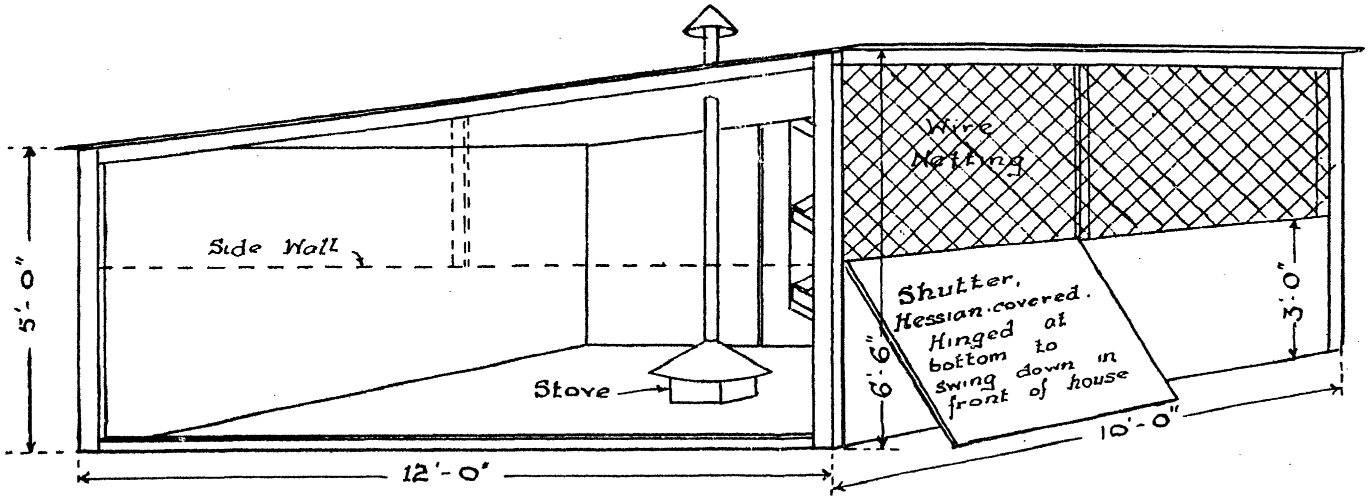
After studying the instructions carefully and having set up the incubator under proper conditions, it should be operated without eggs for a few days to become thoroughly acquainted with the details and for adjustment of the regulating device. An even temperature of 102° to 103° in the egg chamber is required. The thermometers should be tested annually to make sure they are in order before incubation commences. It is advisable to fumigate the egg chamber with formalin after each hatch.

Having thoroughly mastered the operation of the machine and maintained a uniform temperature in the empty incubator, fill the trays. The eggs should be left for several hours to warm up when the temperature will automatically rise to about 103°. After 24 hours the eggs should be turned and aired, and this should be done at regular intervals throughout the period of incubation.

There are no infallible rules for operating an incubator. The amount of moisture and ventilation required, the manner of turning and cooling the eggs and other details cannot be definitely stated for all machines. These are subject to variation according to the type of incubator and climatic conditions. The mammoth machines and some of the smaller incubators are equipped with a turning device and printed instructions for their operation accompany each machine. The usual method of turning eggs by hand in small incubators is to remove the eggs in the centre of the tray to the side or end of the rows, and gently roll those at the side to the centre of the tray. This method may be adopted for turning and cooling the eggs in the morning, but in the evening give each egg a quarter or half turn, then close the drawer without cooling them. As to the length of time the eggs might be left to cool, no hard and fast rule can be given, this must be left to the discretion of the operator. In hot weather, however, when the temperature of the incubator and the room tends to rise, the eggs may be cooled from five to fifteen minutes longer than under ordinary conditions, remembering always that during the last week of incubation the eggs also require more air than they do during the first ten days. Under ordinary conditions the eggs are aired and cooled during the early stages of incubation sufficiently to give best results while they are being turned. A point of great importance is to turn the flame of the lamp very low during the time the eggs are being cooled. The embryo chick generates animal heat as soon as it commences to develop and the volume of warmth increases steadily during the period of incubation. This is the reason why the temperature usually rises during the last week or ten days, and it may be necessary to reduce the flame of the lamp very considerably or to readjust very carefully the regulator during this period. It is inadvisable to tamper with the regulating device during the hatch, but it must be done if after lowering the flame the temperature tends to rise above 105° F.

The normal periods of incubation are as follows:—Fowls 21 days, domestic ducks 28 days, muscovy 35 days, geese 28 days, turkeys 30 days, guinea fowl 26 days, English pheasant 26 days.

Eggs should be tested twice during the hatch, the first test on the seventh day and the second on the fourteenth day.



PORTABLE BROODER HOUSE, WITH BROODER STOVE

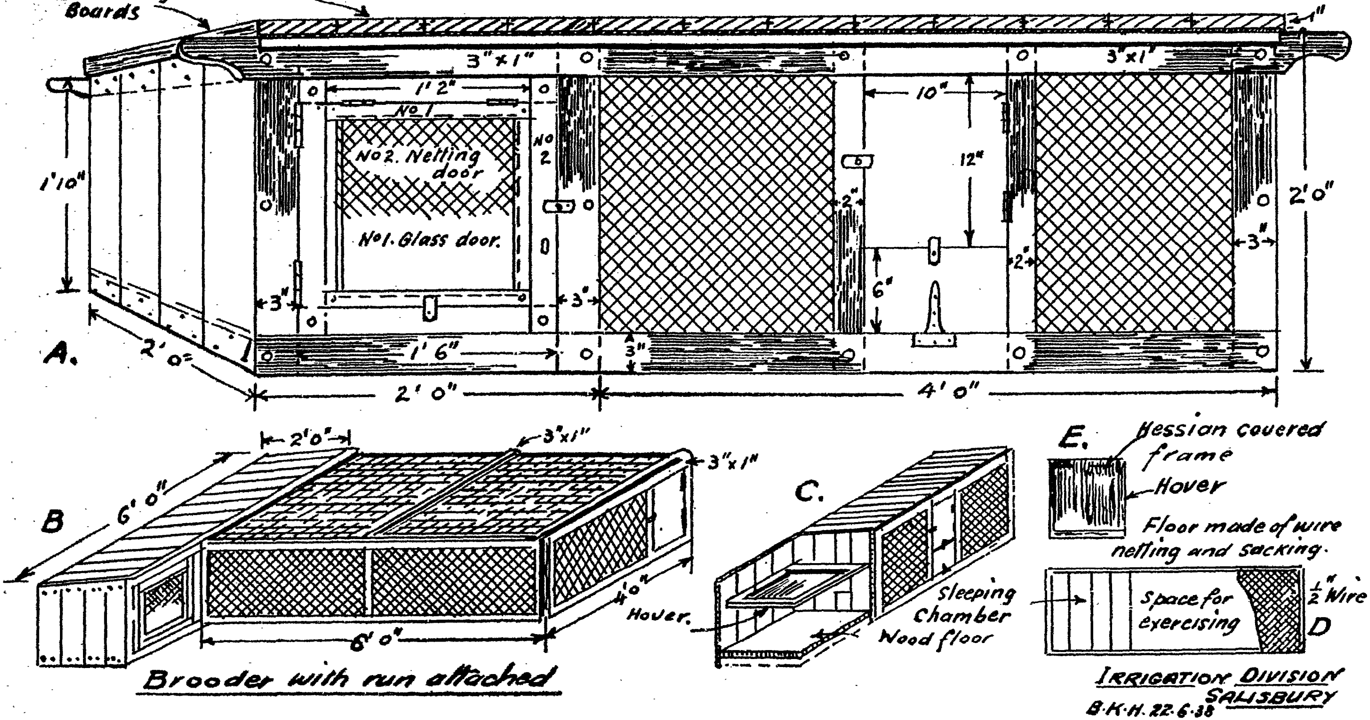
[Side of House Removed.]

At the first test remove all infertile eggs, broken yolks and dead germs. Mark those which may be doubtful and continue to incubate them until the second test. If they do not develop further by that time they should be removed, as well as all other dead and weak germs and addled eggs. Turning of the eggs should be discontinued on the morning of the twentieth day or sooner if the chicks begin to hatch. On the morning of the twenty-first day gently remove empty shells and place the hatched chicks in the drying box, or as provided in some machines in the nursery trays, and allow them to dry off for twenty-four to thirty-six hours, when the chicks should be removed to the brooders. The brooders should be thoroughly cleaned and littered with grass. Fireless or cold brooders should be placed with the chicks in a sheltered sunny locality, taking care to provide shade when required. From this stage until a few days old the chicks will require frequent attention, and it is important to avoid excessive exposure during the early morning and evening to avoid chilling. The activities of the chicks will indicate plainer than words whether they are comfortable or not. If crowding together and chirping, their usual requirement is warmth. Close observation and careful management will ensure good growth to marketable age or maturity of a large percentage of the chicks placed in the brooders after hatching.

Artificial Brooding.—Artificial brooding is comparatively simple when the requirements are thoroughly understood. Although constant attention and observation are necessary. any system other than artificial brooding in the case of chicks hatched and raised on a commercial basis would be too laborious and out of the question. The main object is to provide facilities for protection and to keep the chicks warm and comfortable during the early stages after hatching. They should be kept under control and provided with conditions to encourage good health and robust development. The care and attention given to chicks during the first two weeks, the critical period of their life, determines to a great extent their future value. The most satisfactory and economical types of brooders are generally those that are portable.

There are two types of artificial brooders, both of which have proved satisfactory and adaptable to the requirements of

OUTDOOR COLONY BROODER.



the poultry farmer for brooding chicks in either small or large units. They are the fireless or cold brooder (a misnomer) and heated brooders. The most essential requirements are efficiency, convenience, economy and safety.

Fireless Brooders.—The drawback with most brooding systems is the cost. The need of an efficient, convenient and economical means of brooding chicks in small units is a matter of importance to many poultry keepers, and for this purpose the fireless or cold brooder, such as is shown in the accompanying design, is advocated. The outdoor colony brooder is easy to construct and handle. It affords the necessary protection from vermin and can be moved to fresh ground as often as may be necessary. The capacity of this brooder provides for 50 chicks without artificial heating. This system has been practised for a considerable number of years with satisfactory results in this Colony. Heated brooders are not necessary for brooding chicks in small units in warm localities. Suitable arrangements could be made to equip this brooder with a temporary heating device in the case of emergency when the chicks are to be removed from the incubator during a spell of cold cloudy weather. This requires careful attention, however, to avoid overheating the chicks.

The brooder must be thoroughly clean and the floor littered with grass or straw. The interior of the brooder chamber should be thickly lined with long grass on all sides to provide a fairly deep nest in which to brood the newly-hatched chicks on removal from the incubators and at night. The hessian covered frame or hover is placed over the nest and is pressed down to within one or two inches above the chicks in the nest. As the chicks require more room and ventilation so the nesting material should be reduced accordingly. Sufficient grass should be left to round off the corners and as a support for the hover. The hover can be raised as the chicks increase in size and removed when they are well feathered. In this way they may be hardened off before their transfer from the brooder at about five weeks of age. The chicks should be confined to the hover section for the first two or three days and the position of the brooder adjusted to admit the sun through the glass door all day. On the third or fourth day they may be given the opportunity of using the exercising

apartment and later allowed in the attached wire run. During the first two or three days the hover must be lifted several times a day at regular intervals for feeding purposes, but the chicks must be replaced under the hover after feeding before they become chilled. By frequent handling in this manner the chicks soon learn what is required of them, and may soon be trusted to take care of themselves when they require warmth. If they show any disposition to crowd or huddle together outside the brooder chamber at any time, place them under the hover to warm up. After they are a week or ten days old they may be allowed access to the wire run. A covering on top of the run is necessary for shade in the absence of shade from trees. Not more than fifty chicks should be placed in this type of brooder, as it is considered the maximum limit of safety. Care must be taken to keep the chicks warm and comfortable at all times, and to provide ample ventilation for them at night. Overcrowding under the hover with insufficient ventilation, especially at night, will definitely impair the vitality of the chicks and will lead to respiratory troubles, stunted growth and mortality. Overcrowding is as harmful as improper feeding.

The chicks should be given the opportunity to exercise in quarters that are not too cramped. They should be provided with sufficient hopper space to allow easy access to the food and water at all times during the day. Sun and air the hovers daily as well as the litter. The litter should be renewed as often as necessary. For poultry keepers who desire to brood smaller lots of chicks—up to 25 in number—a petrol box may be converted into a cold brooder provided a hover and a small run are supplied.

Heated Brooders.—Of the many types of heated brooders the oil burning, electrically heated, or hot water systems are probably the most commonly used. There is also the flue system and coal burning brooder stoves for heating the entire room or apartment for brooding the chicks. All these methods of providing warmth are giving satisfactory results. Heated brooders or apartments must be suitably ventilated.

They are as a rule centrally heated, and in the case of brooder stoves and the flue system the heat generated is greater than the chicks require. The room must be large enough to

provide sufficient floor space to allow the chicks to regulate for themselves the distance from the heater or degree of warmth they require. Such brooder apartments are provided with facilities for ventilation and zones of heat varying in temperature, the chicks being able to choose the temperature most suitable by spreading out on the floor of the room. The room temperature for battery brooders is automatically regulated and controlled.

The oil burning, electrically heated and hot water systems are generally more adaptable to the hover or box and canopy design of brooder. They provide a minimum heating capacity to keep newly-hatched chicks warm and comfortable and are more practicable and economical for brooding chicks in units of moderate size. They meet, with practically no exception, all the requirements laid down for satisfactory brooding and may be placed in any convenient building or in a brooder house designed and equipped for that purpose. Where brooding is undertaken on a large scale with heated brooders a special brooder house is necessary, which must be designed to fulfil the requirements of the heating system to be adopted.

Brooder House.—There are two types of brooder houses generally used for the successful rearing of chickens. They are:—

1. The portable or colony house.
2. A long permanent building sub-divided into pens having either a built-in or portable heating system.

1. Colony brooder houses installed with a portable heating system should be made as large as can be moved conveniently. A house 10 ft. by 12 ft. should be the minimum for units of 300 chicks. A suitable size for units up to 500 chicks would be 14 ft. by 16 ft. A lean-to roof at least 6 ft. 6 in. in front and 5 ft. at the back should suit a house 12 ft. deep, and an uneven span or apex type of roof would be more satisfactory for a house which is 16 ft. deep, the height of the walls being 6 ft. and the roof at the apex 7 ft. 6 in. The accompanying design (Fig. 2) illustrates a brooder house which is considered satisfactory. It can be moved conveniently on most farms. The house consists of a wooden frame with water-tight roof. The sides, back and front should be covered with wire netting,

attached to the inside of the framework. The back wall and lower part of the sides and front should consist of some light weather-proof material, such as galvanised sheet iron, malthoid or rubberoid, etc. This should be 3 ft. high on the sides and front wall. The openings above this may be fitted with hinged wooden frames covered with fine hessian, hinged at the bottom to swing down on the outside of the house. These shutters may be closed for protection when necessary or opened for ventilation and to admit sunshine as may be required.

2. A brooder house constructed of bricks for a built-in or portable heating system should be 12 ft. deep with a passage 3 ft. wide along the interior of the back wall. The house should be sub-divided by wire netting partitions 6 ft. apart for units of 100 chicks or sub-divided into larger sections where the brooding of chicks in larger units is intended. A northern aspect is preferable. Outdoor wire runs should be provided to coincide with the internal sub-divisions of the house. Open fronted houses of this type can be operated successfully in some localities, but provision should be made to eliminate ground draughts by solid dwarf-wall partitions and with hinged cloth-covered frames for closing the open front when desirable in cold weather. In cold climates the front of the house should be enclosed with glass windows to afford the protection necessary. In planning a brooder house, consideration must be given to convenience in attending to the chicks, inspecting the hovers, feeding and watering, disinfecting and cleaning.

Ventilation and Temperatures.—The importance of good ventilation in the brooder house and brooders cannot be too strongly emphasised. Adequate ventilation of the brooder house itself does not necessarily ensure sufficient ventilation of the hovers, these must be provided with facilities to permit free circulation of air.

With heated brooders the temperature is another important factor. Insufficient warmth induces crowding and is harmful; overheating, due to lack of ventilation, causes sweating, causing respiratory troubles, which impair the vitality of the stock. These conditions are particularly observed under hovers equipped with strips of cloth or curtains that hang close to the floor and restrict the circulation of air.

The ends of the cloth should be at least 2 inches from the floor. In operating such brooders additional ventilation and a reduction in the temperature as the chicks grow older must not be overlooked. At the start the temperature in the brooders should be 90° to 95°, and this should be gradually reduced to 65° at the end of the second week. After this the chicks should be brooded without artificial heat for a time before they are transferred to outside quarters.

Brooder Management.—The brooder should be ready for the chicks at least two or three days before the chicks arrive. If it is a new brooder with regulating device make sure it is properly adjusted and that it works freely. The capacity of the brooder should not be exceeded. When too many chicks are brooded together proper control of the young stock and access to the food hoppers is not always possible. Do not attempt to brood chicks of different ages in the same flock under the same hover. The brooder house floor should be covered with clean sand, chaff or finely-cut grass to a depth of 2 inches.

With heated brooders the liberty of the chicks should be at first restricted, confining them within a reasonable radius from the hover by a temporary wire netting screen for the first few days. Advantage should be taken during this period to train the chicks to return independently to the hover for the warmth and protection they require. They will soon learn to take cover, and as they become older and more independent they should be given more room to exercise, and after the end of the first week the whole of the floor space should be accessible to them. At this stage the chicks may be allowed out into the outside runs of the brooder house during fine weather. Observation is necessary on the first occasion, as they may not be able to find their way back into the brooder house. Sanitation and cleanliness under the hovers and in the brooder house are very essential for health and the sturdy development of young stock. The brooder compartments should be thoroughly cleaned and disinfected after the removal of chickens.

Chickens at 5—6 weeks old are generally well feathered, and they should be removed either to outside coops confined in pens, or reared under the colony system. On transferring

them to their new quarters, they will require some attention for several evenings to accustom them to their new surroundings. This attention would be amply repaid and is necessary to obviate overcrowding and possibly mortality. They should be accommodated in units of 50 or a maximum of 100 chicks and separated according to sex. Perches are not necessary at this stage, but the floor of the house should be well littered and the corners rounded off with grass, or preferable with wire netting, to prevent corner crowding. As the chickens develop the number should be reduced according to the size of coops in which they are accommodated.

Feeding.—The proper feeding and management of the young stock determines to a great extent their future value as breeders and layers.

Growing birds want variety, if for no other reason than to maintain their appetities, and there must be not stinting of food although waste must be avoided. There is an axiom in the management of stock that the "feeding must be above the breeding" if improvement is to be obtained. While it is true that improved results would be secured by sound methods of feeding, it is equally true that still better results would be obtained by having the stock properly bred and properly fed. In this way the greatest return would be derived from a given amount of food.

The object of the poultry breeder to-day is to economise in almost every branch of his business, but there is one place where stinting is false economy, and that is in the supply of food. It is much better to hatch fewer birds and feed them well within one's-means than to try and raise a large number that may be undernourished.

The successful feeding of chicks is not a difficult problem provided they are supplied with their natural requirements. Almost any wholesome nitrogenous ration made up of grain and grain by-products, green food and animal food given regularly is what they require in the way of food and they must always have access to clean water and grit.

The chicks will be ready for their first food 36 to 48 hours after hatching. It is necessary to bear in mind that the newly hatched chick, by absorption of the yolk of the egg

just prior to emerging from the shell, has been provided by nature with sustenance for the first 48 hours after hatching. Feeding therefore, too soon after hatching, is not only unnecessary but undesirable and may prove harmful.

The food should be given preferably when they have been removed from the incubator to the brooder. They should be provided with shallow vessels each containing dry mash, water and a little grit. Two or three pieces of straw may be allowed to float on the surface of the water, which the chicks will peck at, and soon learn to drink. At frequent intervals during the first two days their attention should be drawn to the food, either by tapping the food with the fore-finger or by taking a pinch of the mash between the fingers and allowing it to sift down from a few inches above the food tray. By these simple means chicks can be taught to eat and will soon learn to care for themselves. A small quantity of pinhead oatmeal may be given twice a day as an additional feed during the morning and evening. From the third day a little munga or commercial chick food may be given in conjunction with the dry mash substituting the oat-meal and feed at frequent and regular intervals during the course of the day.

The best results are obtained by the dry mash system of feeding, either combined with grain or fed as an "all-mash" ration without the use of grain. This all-mash ration simplifies feeding in the early stages, and when it is desired to feed grain with dry mash it can be done by substituting grain for portion of maize meal, oats and pollard.

When the feeding of moist food is adopted, the mash should be mixed to a crumbly consistency with separated milk or warm water, and the chicks given only sufficient to be consumed in half an hour. The food left over after that time should be removed. Moist mash may be fed in conjunction with dry mash as a regular system in the rearing of table birds. For stock that are intended for the laying and breeding pens, however, the mash in a moist state should be regarded as supplementary especially for late hatched chicks and chicks that have gone off their feed. A moist mash as a change stimulates their appetite and encourages them to consume their full requirements and so to maintain good growth

and development. Grit and water are necessary at all times, and finely cut tender green vegetation must be given daily. Bone meal, lime and salt as a mineral mixture may be incorporated in the mash for all ages of growing stock. Separted milk, when available, is a desirable addition given either mixed with mash as a moist food or the curd given in separate receptacles. It is better to give the curd after draining off the whey when milk is supplied separately.

The grain mixture or munga should be fed in loose litter, which will induce the chicks to exercise by scratching for it. Give the grain at least four times a day, in small quantities at regular intervals. As the chicks grow older accustom them to a larger range or run, placed with the brooder on grass covered ground. The site which has been set aside for rearing should be planted preferably with a permanent grass such as couch. This serves to sweeten the land during the off season and furnishes green pickings for the chicks and two or three cuttings of grass of desirable length during the rainy season for use in the brooders.

When the chicks are eight weeks old give them a mixture of larger grain, such as cracked wheat or crushed mealies mixed with munga and sunflower seed. By the time the chicks are six to eight weeks old the principal dangers of chickenhood are past, and at this stage they may be removed or weaned from the brooder to suitable coops. The rearing can be continued in wire runs or by the colony system.

The chickens may, when old enough be allowed free range under the colony system where they can have freedom under natural conditions, but they must be given a liberal supply of nourishing food ad. lib. to ensure steady, healthy, continuous growth. Guard against insect and other vermin and keep the coops clean and dry.

Chickens intended for laying or breeding purposes should be carefully selected when young, the first selection being made when they are eight weeks old. Separate all the cockerels and house them apart from the pullets. Those showing retarded growth should be separated from the more robust ones and placed in a pen for fattening. A regular practice of culling the young stock is advocated, by which essential

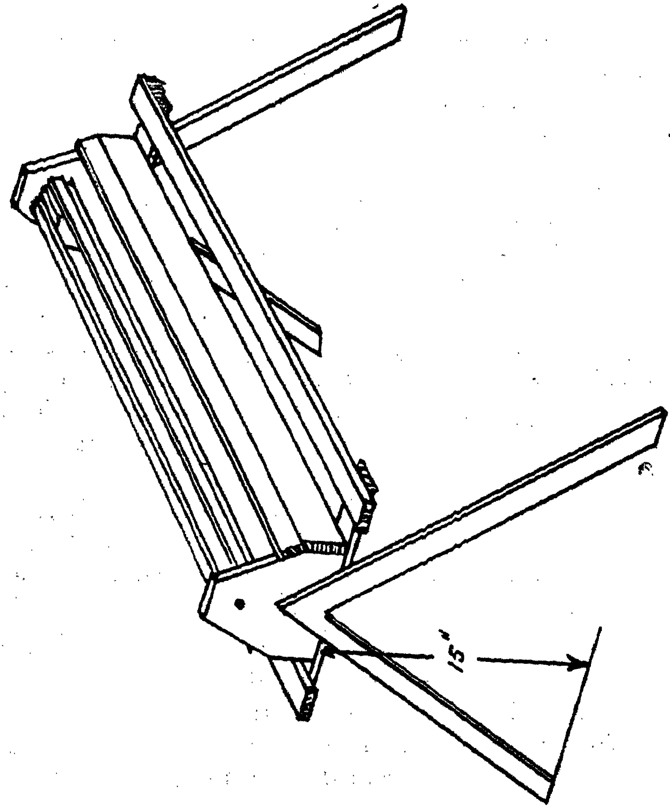
economies may be effected. The stock showing evidence of lack of stamina and the cockerels having standard defects should be drafted from time to time to the fattening pens for disposal.

Self-feeding hoppers are of the greatest advantage in feeding poultry of all ages. By using hoppers for the dry mash, time and labour will be saved. This method of feeding is the cleanest, easiest and best way to feed poultry. The hoppers should be replenished daily or in the case of self-filling hoppers less frequently depending upon size of flock. The chickens should have access to the food all day and sufficient hopper space must be provided to enable all the chickens to feed comfortably without overcrowding and molesting each other. Double sided hoppers are recommended 4ft. long for 100 chicks and an intermediate size for half grown stock should be 6 ft. long. The size of hopper accommodation required for adult stock should be based on the equivalent of one inch per bird.

The value of green food throughout the whole year cannot be too strongly emphasised either in a fresh succulent form or supplied as leaf meal in the mash. Leaf meal may be soaked in water for an hour and fed to the birds after draining in place of succulent green food.

At the age of five months on reaching laying maturity they should be fed on the mash and grain mixture for adult stock.

There are many grains and meals obtainable in Rhodesia which are suitable for feeding to poultry, a good ration may be made up to suit the poultry farmer from the variety of foodstuffs available. The accompanying rations consist of foodstuffs that are generally easily available and have proved satisfactory. The digestibility, general analysis and palatability of the constituents are important and must be taken into consideration in compiling efficient rations. Some farm-grown foodstuffs may be substituted but they have been found less palatable and more indigestible as a rule. To force young stock to consume food that does not furnish the necessary nutritional requirements or that is not palatable and of good quality would seriously retard their growth. In the case of laying stock lowered productivity would be the result.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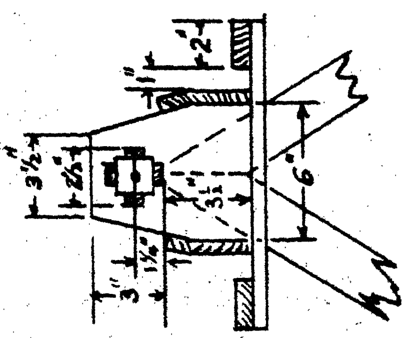
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During the early stages, the rate of growth of the chick is chiefly limited by its capacity for the consumption of food, and although there is at present no data available by which to determine the exact requirements of the chick for protein and carbohydrates, it has been found there is little possibility of over-feeding a chick in its early stages of growth and that the food mixtures usually given to chicks during the early stages are deficient in protein.

The following ration based on these observations have given excellent results. The chickens grow and feather more quickly and the rearing mortality is reduced to a minimum.

With a view to simplifying chick rearing, the following ration was tested at the Salisbury Experimental Station, where it has since been used for a number of years in the rearing of Light and Heavy breeds of fowls. The results have proved so satisfactory that this ration from hatching to maturity can be recommended.

CHICKEN REARING RATION.
HATCHING TO MATURITY.

Mash Mixture.

Bran	10 lbs.
Pollard	17 lbs.
Mealie Meal	45 lbs.
Oats (rolled or meal)	10 lbs.
Meat or fish meal ... ... (to 12 weeks)	10 lbs.
Monkeynut cake (ext.)	10 lbs.
Milk, thick separated if available to 10 weeks (optional)	
Bone Meal	2 lbs.
Salt (fine)	½ lb.
Lime (limestone or powdered oyster shell)	1 lb.
Charcoal	1 lb.

Grain Mixture—from 8 weeks.

Crushed maize	60 lbs.
Munga	30 lbs.
Sunflower seed (small) (optional)	10 lbs.

The above mash may be fed alone during the early stages of growth or in addition munga as a grain feed may be given

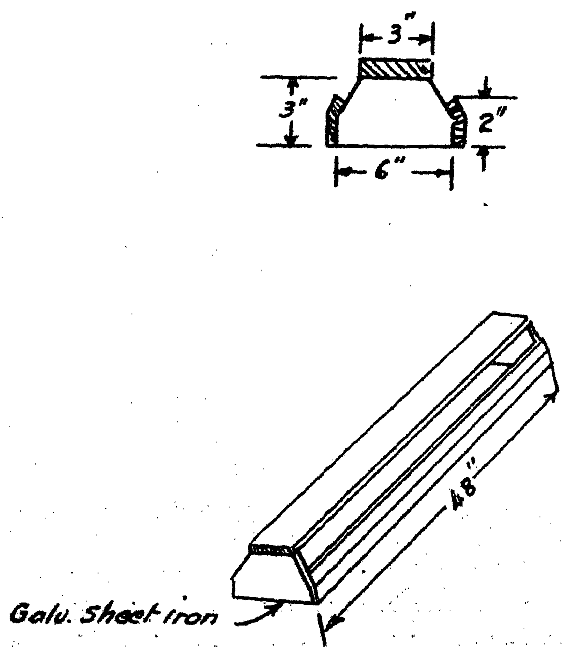
from the first week to 8 weeks old, thereafter, add crushed maize and small sunflower seed, the latter being optional.

From 12 weeks onwards omit meat or fish meal, the other ingredients remaining the same.

When thick separated milk is available, reduce the meat meal to 5 lbs. In the event of oats being too costly substitute by increasing the maize meal by equivalent weight of oats.

A liberal supply of green food is essential for all ages of growing stock especially when white maize is used. Part may be mixed for convenience in the mash in the form of lucerne or sunflower leaf meal in addition to succulent green food given daily.

General Observations.—The mortality of young chicks is not always due to disease and parasitic vermin; losses may occur from several other causes which are often overlooked and can be forestalled.



Overcrowding and Chilling.—The brooding of chicks in quarters that are comparatively restricted is accompanied by some danger of overcrowding and suffocation. When the chicks are too cramped and without sufficient ventilation suffocation may result particularly at night. Overcrowding occurs also outside the brooder during cloudy weather and chilling may result. Chicks that are unable to find their way back to the brooder chamber or young chicks that are exposed too long at sunset will become chilled. It is particularly important to avoid possible chilling during the day and overcrowding at night when the chicks are very young.

Another source of danger arises on removal of the chickens from the brooders. During the first few nights careful observation would be well repaid, as they will overcrowd, especially in chilly weather, or they may not find their way back into the new quarters. If left outside overnight mortality will result. At this stage overhead protection placed about 2 ft. above the floor, to take the place of the hover, and having the corners of the pens rounded off are necessary precautions to avoid losses.

Bowel Trouble.—The derangement of the digestive system of young chicks is caused by a number of conditions including chilling, improper feeding, sun-warmed water, overheating or stale and inferior quality foods. Digestive disorders during the early stages of growth may be the result of feeding the chicks too soon after hatching or of allowing them access to moist mash that has fermented. Always supply clean water, fresh wholesome food and provide shade for the chicks and drinking water.

Sanitation.—Sanitation checks disease and must be regarded as one of the important considerations in successful chick rearing. Many common diseases and troubles of both old and young stock can be avoided by following sanitary principles. Proper sanitation means raising chicks on fresh ground, moving portable brooders from place to place at intervals or in the case of permanent runs digging them over and growing a crop in the off season. Contaminated ground should be treated with lime during the rainy reason. Renew-

ing the litter in the brooders as often as necessary and consistent cleaning of utensils and disinfecting brooders after each lot of chicks are weaned, are essential points in sanitation.

Cannibalism or Toe Picking.—This is frequently very difficult to deal with and when an outbreak occurs every effort should be made to nip the trouble in the bud. As a rule one or two birds are the culprits, the others simply join in the feast, and it is only by close observation that the ringleaders may be detected and if removed in time it is probable no further losses would occur.

Cannibalism is often associated with poor hatches and unthrifty stock. The latter may be brought about by too close confinement in the brooders and runs or by having insufficient hopper accommodation. Under such conditions the tendency for the chicks to peck and bully and injure one other is greater. On this account overcrowding is one of the most common causes of cannibalism and the danger under these circumstances becomes a very real one.

Much of this trouble can be avoided by furnishing the chicks with proper nourishment and brooding them in smaller units. There should be no delay in culling the weak stock, separating the sexes and transferring them to larger quarters. Anything that can be done to keep them busy deserves consideration, such as encouraging them to forage about in the runs, the feeding of grain in litter and hanging up in the runs several bunches of green food within easy reach. These means encourage scattering and exercise and in this way healthier chicks are produced.

Eighteenth Annual Report of the Division of Forestry

FOR THE YEAR 1937.

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Conservator of Forests.

INTRODUCTION AND SUMMARY.

The year under review has been notable for the protracted dry season, which lasted almost two months beyond the average. These conditions imposed a severe strain on plantations in many areas, but served once again to point the moral that the extremes rather than the average of climatic factors must govern the choice of species to be grown. The long dry season was also naturally reflected in a vast number of veld fires which ranged the country, and the exceptional toll of forest and grazing re-awakened public concern at the heavy losses which the country sustains annually.

That satisfactory protection of indigenous forest is possible at small cost is shown by the activities of this Division, which out of a total protected area of 566,500 acres suffered damage to the extent of only 1.89 per cent. during the past year.

It is of interest to record the following average annual costs of fire protection in various classes of forest.

In the indigenous *Baikiaea plurijuga* forests of the Kalahari sands, where extensive protection operations are carried out, the cost is 0.43d. per acre.

In coniferous plantations of the Stapleford Forest Reserve in the mountain grasslands of the Eastern Border intensive fire protection costs 8.96d. per acre.

In coniferous and eucalypt plantations of the Mtao Forest Reserve, which is situated in typical heavy savanna forest country subject to great fire hazard, the cost is 1s. 3½d. per acre.

Kalahari Sand Forests.—Fire protection operations were commenced in the Ngamo Forest Reserve, and in this and the Gwaai Forest Reserve, and the Fuller and Masue Forests, a total of 566,500 acres was protected, of which only 1.89 per cent. was traversed by fire.

In the Gwaai Forest Reserve enumeration surveys were carried out over 95,000 acres and virees were laid out preparatory to the survey of a further 10,000 acres. The enumeration surveys of the Fuller and Masue Forests were completed.

All these areas have been rendered more accessible by the construction of roads and the use of motor transport.

Mtao Forest Reserve.—A pleasing feature of the year's work was the greatly enhanced sales of eucalypt timber, of which 20,083 cubic feet were sold compared with 900 cubic feet for the previous year.

The increased demand is due partly to the unique position of Mtao as a centre for distributing poles to Matabeleland and partly to a growing lack of accessible indigenous mining timbers.

As a result it was possible to carry out much-needed thinnings with financial justification in many areas where the operation was silviculturally desirable.

Unfavourable weather and the failure of certain pine seed to germinate in the nurseries resulted in a curtailment of the planting programme, but the area of plantations was increased by 140 acres to achieve a total planted area of 2,200 acres.

The Chaka Forest Nurseries of Mtao continued to give employment to elderly men not in receipt of an Old Age Pension. The average number of men employed was 42, and the health of the camp throughout the year was excellent.

Stapleford Forest Reserve.—Gratifying progress was made in topographical surveys with the result that they are now ahead of the planting programme to the extent of at least one year's operations. A considerable increase in path construction was also achieved.

The incidence of the rainfall at the beginning of the year curtailed the projected extension of plantations, but during the year 572 acres were planted, bringing the afforested area up to 4,435 acres.

The European Unemployment Relief Camp continued on a small scale with an average number of 12 men.

Forestry in Native Reserves.—The Forest Officer for Native Reserves inspected twelve reserves during the year, mainly in connection with the utilisation of timber. He reports a pleasing tendency on the part of natives to carry out tree planting on their own initiative, and draws attention to the beneficial results on forest growth which are already apparent since the inception of a centralisation policy.

National Parks and Game Reserves.—The Division lost a valuable official during the year in the death of the genial Captain J. J. Reynard, whose untiring efforts as Curator of the Victoria Falls Reserve enhanced considerably the popularity of this resort.

A steady increase of game continues in the Victoria Falls Game Reserve, which is also the Masue Forest Area. This gradual return of game to an area from which they were driven by timber exploitation in the past, should result in an additional and easily accessible attraction to visitors to the Falls.

From the Wankie Game Reserve, in spite of the dry year, migration of game was less than usual. To a certain extent this may be ascribed to the success of borehole water from windmills which maintained a supply in pans until the advent of the present rainy season.

Regular patrols to the extent of 16,420 miles were carried out by the Game Wardens and native rangers.

A new road, 45 miles in extent, was completed.

There were 143 visitors to the Reserve, and of these 71 made use of the rest huts.

At the Rhodes Inyanga Estate the first trout fishing season was opened in November, three years and four months after the first introduction of fry. Owing probably to the

abnormally low water catches have not been large in numbers, but the growth and sporting nature of the fish taken was remarkable. The largest fish taken scaled $7\frac{1}{4}$ lbs.

Two rest camps, each consisting of two bedrooms, a living room and detached kitchen and store, were opened to the public and were well patronised. A further rest camp was completed at the close of the year.

Road work was undertaken to open up new places of interest on the Estate, small plantations of exotic pines were established, and the stocking of streams with rainbow trout was continued.

State Forests.—The Bembesi Forest Reserve (108,960 acres) and the Inseze Forest Reserve (86,240 acres) were reserved provisionally during the year.

The Ngamo Forest Reserve, in which no work has previously been carried out, was opened as a result of the completion of exploitation under a previous concession, and the exclusion of the area from free shooting.

The boundary between Seafeld Estate and the proposed Inseze Forest Reserve was defined and a portion of the boundary of the proposed Bembesi Forest Reserve was cut open.

The north-western and south-eastern boundaries of the Gwaai Forest Reserve were defined by a licensed surveyor, and only one beacon remains to be fixed before the Reserve can be completely defined.

By the Land Apportionment Amendment Act, 1937, the Gwampa area previously surveyed by the Division again becomes Crown land, and steps are being taken to set aside the area as Forest Reserve.

Management.—Topographical surveys were continued at Stapleford, and it is gratifying to be able to report that all the planted area and a considerable area of unplanted land are now surveyed.

At the Mtao Forest Reserve a commencement was made with the enumeration of older plantations of eucalypts, but was suspended owing to pressure of other work.

Enumeration surveys were continued in the Kalahari sand *Baikiaea plurijuga* forests. Surveys in the Fuller and Masue Forests were completed. In the Gwaai Forest Reserve 95,000 acres were enumerated, and a further 10,000 acres were opened with virees preparatory to stock mapping. An area of 25 square miles of Umgusu forest in the Gwaai Native Reserve was surveyed by the officer attached to the Native Department. Only small quantities of merchantable timber were revealed.

Owing to seed failures and time expended on thinning operations the Annual Plan of Operations framed for the Mtao Forest Reserve will not be completed and the planting programme has been curtailed.

Several valuable sample plot measurements were made at Stapleford and Mtao.

Further experience in the Umgusu forests did little to lessen the anxiety felt regarding the future of these forests and timber industry. Nevertheless, data are rapidly accumulating which will enable recommendations to be made regarding the limitation of cutting.

The introduction of protection in forests which at present are being depleted annually by fire and the raising of the minimum girth limit to be exploited are considered to be essential as a means to this end.

Protection.—Fire.—All forest reserves were regularly patrolled, and in spite of a severe fire season the areas burnt were remarkably small.

At Mtao 147 miles of fire-guard were maintained. No fires occurred. The protected area includes the whole Reserve. Fires in the district were very severe.

Three hundred acres of unprotected grass land were burnt at Stapleford. Ninety-nine miles of fire-guard were maintained. In addition to patrols, native look-outs were posted with drums on two prominent points and a watch was maintained during the night on Mt. Chililankwe.

Nearly 500 miles of fireline were maintained in the Umgusu forests and 566,500 acres were protected. The area

burnt, 10,700 acres, was only 1.89 per cent. of the total, a truly remarkable achievement.

Of the fires which did occur only one did any appreciable damage. This fire covered 6,800 acres in the Gwaai Forest Reserve and regeneration received a set-back from which it will take two to three years to recover.

It is pleasing to be able to report that resident natives on the Gwaai Forest Reserve are gradually developing a forest conscience, and the assistance of the Native Department to this end is gratefully acknowledged.

Animals.—Damage to young trees by spring hares continued to be severe on the Mtao Forest Reserve. Shooting of these animals was continued without any noticeable decrease in their numbers.

A serious infestation of cockchafer grubs occurred in newly-planted areas and losses were severe.

Phorocantha semipunctata was discovered attacking *Eucalyptus microcorys*, but this is not causing alarm, as the tree has proved itself unsuited to the area owing to dry conditions and is being removed.

Caterpillars defoliated young pine plants at Stapleford, *Pinus radiata* and *Pinus muricata* being especially subject to attack.

Cutworms were troublesome in the nurseries and hand-picking had to be resorted to.

A sum of approximately £30 was expended out of the votes of the Kalahari sand forests in assisting the Medical Department to combat the introduction of bubonic plague.

Natural Causes.—Losses from drought among newly-planted trees were severe at Mtao. Frost damaged coppice growth of indigenous tree species and also new shoots of *Aleurites fordii* and *Eucalyptus saligna*.

Frost and drought did a certain amount of damage at Stapleford, and *Pinus insularis*, *Eucalyptus paniculata*, *Euc. microcorys*, and *Syncarpia laurifolia* were the worst sufferers.

Frosts were severe in the Umgusu forests, particularly in areas fringing vleis. Further effects of the invasion of Umgusu areas by *Brachystegia randii* were noted.

SILVICULTURE.

Natural Reproduction.—In the Umgusu forests *Baikiaea plurijuga*, the Umgusu seeded patchily, but on the whole satisfactorily and further regeneration took place.

The seedlings from the good year of 1936 continued to make progress.

One of the essentials for regeneration in this area appears to be disturbance of the soil, such as occurs during exploitation, and the District Forest Officer emphasises the necessity for protection immediately following on such operations.

Copaifera coleosperma, m'chibi, seeded well, but little regeneration of this species was noted.

At Stapleford natural regeneration of *Pinus patula*, *Cupressus lusitanica* and various eucalypts occured.

Artificial Reproduction.—Afforestation carried out during the year was as follows:—

Station.	Revised area afforested at 31.12.36.	Afforested during 1937.	Total area afforested at 31.12.37.
Salisbury Forest Nursery	43.50	11.5	55.0
Mtao Forest Reserve... ...	2,064.81	140.75	2,205.56
Stapleford Forest Reserve	3,863.84	572.30	4,436.10
Totals	5,972.15	724.55	6,696.66

The area afforested is less than was intended, due to the fact that a large proportion of the seasonal planting at Mtao was carried out in December, 1936, and weather was unfavourable for the completion of the programme at Stapleford.

Nurseries and Sale of Seeds and Transplants.—Four nurseries were maintained on the Stapleford Forest Reserve, one of which was extended.

Pinus palustris seed failed almost entirely and *Pinus canariensis* damped off severely in December.

Cutworms caused considerable damage, but were kept in check by hand-picking.

The Chaka nursery, staffed by old Europeans, who are paid at the rate of £5 per month in lieu of a pension, was maintained at Mtao Forest Reserve.

Plants were supplied for use on the Reserve and small quantities were sold to the public.

Seed of *Pinus longifolia* and *Pinus palustris* failed almost entirely and the loss will materially affect the planting programme.

Experimental work in propagating indigenous trees from seed and truncheons was commenced.

The Salisbury Forest Nursery continued to supply the public and Government stations throughout the Colony.

Sales from this nursery showed a satisfactory increase of £105 over the previous season in spite of the lateness of the rains.

The value of plants issued free to Government institutions was £826 19s. 5d., while the total revenue was £2,363 10s.

Over 1,500 people visited the station during the year. The question of obtaining suitable tins for transplants is becoming extremely serious owing to importation of petrol in bulk, and enquiries are at present being made for other sources of supply.

Operations for Improvement of the Growing Stock.—Pruning experiments were continued at Stapleford and some interesting results obtained.

Natives using a pruning saw devised by the British Forestry Commission pruned 20.22 trees per hour, while with a common type of pruning saw only 16.91 trees were treated in the same time.

The trees on which this experiment was carried out were nine years old *Pinus patula*, with an average D.B.H. of 4-5 inches. Pruning was carried out to a height of 6 feet. To this height there were on an average 7 whorls with 4 branches, 0.8 inches in diameter, per whorl.

Other experiments of a similar nature showed consistent superiority of the British Forestry Commission saw. Approximately 100 acres of eucalypt stands were thinned during the course of the year at Mtao to supply orders for timber, and thus much of this urgent work has been carried out. Nevertheless, a great deal of thinning still requires to be done at this station.

In the Kalahari Sand Forests slashing of undesirable shoots in dense clumps of regeneration was carried out and selected trees were pruned over an area of 95 acres.

Trial of new Species and Silvicultural Notes.—No new species of importance has been tried out. At Stapleford *Pinus insularis* continues to make good growth in areas free from frost. *Pinus palustris* five and a half years old now averages about seven feet in height, and *Pinus montezumae* is growing satisfactorily.

Mimosa bracatinga continues to grow satisfactorily at Stapleford and Salisbury, but suffered from drought at Mtao.

Rat damage at Stapleford was rather more severe than usual, particularly with *Pinus caribaea* and *Pinus longifolia*.

Various eucalypts which were planted in trial plots at Mtao some years ago have finally succumbed to conditions to which they are unsuited.

Herbarium.—Two hundred and twenty-three specimens were despatched during the year to the Imperial Forestry Institute and ninety-six determinations were received. In addition, forty determinations were received in respect of specimens previously despatched. Two hundred and ninety-four mounted specimens were added to the Herbarium.

EXPLOITATION.

At the Mtao Forest a remarkable increase in demand has been experienced for eucalypt timber, more especially during recent months. While this can to a great extent be accounted for by building activity in Matabeleland, and the increasing tendency in the Colony towards the erection of multiple storey buildings necessitating supports for concrete floors, there is a tendency for mines to rely to a greater extent on this timber for their requirements.

Enquiries made in the Salisbury area reveal a similar demand for poles and considerable quantities have been sold from private plantations.

Sales for the calendar year from the Mtao Forest Reserve totalled 20,083 cubic feet, giving an approximate nett revenue of £692 19s. compared with 901 cubic feet and £55 9s. 10d. in 1936.

The disposal of this timber has permitted much of the urgently required thinnings to be carried out, and it is hoped that, with continued sales, it will be possible to carry out a more regular thinning programme in the eucalypt plantations.

Exploitation of Umgusu (*Baikiaea plurijuga*) in the Kalahari Sand Forests continued on Crown lands, Native Reserves and private lands.

The output during 1936 from Crown lands amounted to 473,500 cubic feet of sawn timber, an increase of 15,000 cubic feet.

The year under review was notable for a change of a far-reaching nature.

As a result of a survey carried out during 1936 a new agreement was entered into between the Rhodesia Native Timber Concessions and the Native Department, whereby certain classes of timber on approximately 1,000 square miles of land in the Gwaai Native Reserve were purchased for a lump sum based on volume in the round instead of on sawn output as hitherto.

This is the first major occasion on which timber has been sold in the round, although the method has been advocated by this Division since its foundation.

As noted last year, the proposed introduction led to increased attention by the Concessionaires to the better utilisation of their timber, and it is gratifying to record that further improvements in technique have been introduced in the year under review, more especially in regard to the better handling of logs in the mill.

Imports and Exports of Wood and Wood Products.—According to publications of the Statistical Bureau, imports for 1936 increased by £19,174 to £204,542, and exports increased by £27,482 to £115,489 over the year 1935.

EXPERIMENTS.

At the request of the agents of a large importing firm in Liverpool attempts were made throughout the year to obtain gum arabic from the various species of *Acacia* growing in the Colony.

These experiments have so far been disappointing, mainly owing to the fact that forest reserves contain little acacia forest.

Samples of the nuts of *Hyphaene ventricosa* have been despatched to China for button manufacture, and these have been favourably reported on by a firm in Shanghai, which states that they are similar to the Dom nuts of commerce. Further samples will be despatched, but before a trade can be established it will be necessary to train labour to remove the hard outer shell.

Experimental tapping of conifers for resin production has been commenced at Stapleford in recent months, and it is anticipated that valuable information may shortly be forthcoming.

In conjunction with the Lion Match Factory, which has started operations in Salisbury, timbers suitable for the manufacture of match boxes were sought. Up to the present no timber of which there is a sufficient quantity available for regular supply has been found, but tests are proceeding with the timbers of *Pinus patula* and *Pinus radiata*.

During the course of the year a report was received from the Forest Products Laboratory at Princes Risborough regarding the suitability of Rhodesian grown *Eucalyptus citriodora* and *Eucalyptus maculata* for tool handles. These timbers were favourably reported on and appear to be comparable with ash or hickory, although it is pointed out that owing to their greater density and stiffness experimentation will have to be carried out to determine the most suitable proportions of the pick handles, especially with reference to the form of the cross section of the handle.

COMMUNICATION AND BUILDINGS.

Roads.—All Forest Reserve roads were kept in repair.

The new deviation over the Mutarazi River beyond the boundary of the Stapleford Forest Reserve was gravelled and

opened for traffic. Approximately two miles of road were constructed on the Reserve partly by European labourers.

Twenty-seven and three-quarter miles of bridle path were constructed.

On the Gwaai Forest Reserve the road from the district headquarters to the Amandundamella vlei was completed, and the north-western boundary fire-line was opened up sufficiently to form a road from headquarters to the Victoria Falls-Bulawayo road. An old road along the Bembesi River was re-opened.

Buildings.—Preparations are in hand at Mtao for the erection of new quarters for the Forester at Fairfield.

Sundry alterations were made to the District Forest Officer's quarters at Stapleford and other buildings were kept in repair. A look-out tower was constructed on the summit of Mt. Chililankwe, and a two-roomed cottage was constructed for the Welfare Officer at the European Labour Camp.

Improvements were made to the District Forest Officer's office at Gwaai.

Telephones.—The internal telephone system was maintained at Mtao Forest Reserve, and at Stapleford it was extended to the look-out tower on Mt. Chililankwe and to the learner's quarters on the central patrol.

The public telephone line was also extended on this Reserve and is now connected to the Meteorological Station on Mt. Nuza and to the District Forest Officer.

Livestock.—The livestock on hand at forest stations at the end of the year consisted of 7 horses, 2 mules, 188 oxen and 68 donkeys.

FINANCIAL RESULTS.

The revenue, unaudited, for the year, including free issues, and timber royalty derived from Ngamo Forest Reserve, amounted to £7,459 7s. 11d., an increase of £1,278 8s. 3d., as compared with the total of £6,180 19s. 8d. in 1936.

Expenditure, unaudited, exclusive of salaries and allowances of the permanent staff, amounted to £7,725 18s. 10d., an increase of £106 3s. 4d.

ADMINISTRATION.

Permanent Staff.—The permanent staff at the end of the year consisted of the Conservator of Forests, five District Forest Officers, eight Foresters, one Nursery Manager and one Assistant Nurseryman, two Learner Foresters, a Game Warden and a Learner Game Warden, the Curator of the Victoria Falls, the Manager of the Rhodes Inyanga Estate and a clerk. Total 23.

The title Chief Forest Officer was changed to that of Conservator of Forests early in the year.

Two Foreman Foresters were promoted to the rank of Foresters during the year.

During the year the death of Captain J. J. Reynard, Curator, Victoria Falls, occurred and Learner Posselt resigned.

A District Forest Officer continued to be seconded to the Native Department.

Temporary Staff.—Employment continued to be given at the Chaka Nurseries on the Mtao Forest Reserve to old Europeans, and the number normally employed averaged 42.

Similarly at Stapleford Forest Reserve the European camp was maintained for unemployed men, the average number in camp being twelve.

Considerable difficulty was experienced in obtaining sufficient native labour for the efficient running of Forest Stations, and this was exceptionally pronounced in the Kalahari Sand Forests, at Mtao Forest Reserve and the Wankie Game Reserve.

Private Forests.—It is unfortunately impossible to give the area under private forests, as this information is not yet available. It is considered probable that the area planted on farms was well up to the average.

During the course of the year a determined effort was made by the Division to encourage tree planting by tobacco farmers, particularly on farms where the indigenous timber supplies are becoming rapidly depleted. To this end special tours were made in the Rusape, Umvukwe and Ayreshire-Sipolilo districts.

In all, during the course of the year 37 farms were visited and addresses were given to three Farmers' Associations. A broadcast address was also given on timber conservation and tree planting.

The Salisbury and Umtali Agricultural Shows were attended and inspections were made and reports drawn up on the plantations at Gwebi and Hillside.

An inspection was also made of the Arboretum at the Rhodes Matopo Estate and recommendations submitted for its improvement. A report was drawn up for the Salisbury Municipality on the City plantations.

NATIONAL PARKS AND GAME RESERVES.

Wankie Game Reserve.—Regular patrols were carried out by the European staff and native rangers. The Game Warden was assisted by a European until July, when the latter was transferred. Difficulty has been experienced in obtaining suitable natives to act as special native constables, who, after the training they have received, are in great demand as compound police in neighbouring mines.

Poaching was to a large extent negligible and confined for the most part to the south-western corner of the Reserve. Proceedings were taken against seven persons and convictions secured.

One hundred and forty-seven people visited the Reserve and saw on the average one head of game per mile.

The Game Warden draws attention to the fact that the name of the Reserve is misleading, many intending visitors proceeding to Wankie, which is fifty miles distant.

At present no charges are levied for the use of the Rest Camps and guides.

Platforms at water-holes were transferred during the year from trees to windmills, and it is somewhat surprising that although these are more comfortable, they have proved less attractive to visitors.

Veld fires were severe, but their origin, except in one instance, was not discovered. Approximately 45 miles of new road were constructed and the system now extends to about 180 miles.

Much interesting information was obtained by a flight over the Reserve in November. No observations could be made on its effect on game nor could any game be seen owing to the height at which the flight was made. It was nevertheless possible to locate a new and apparently permanent water supply, as well as to obtain an excellent idea of the topography of the country and of the forest types.

The centre of the Reserve, which is to a good extent inaccessible owing to dense thorn scrub, was found to be exceedingly dry and to contain only very small pans unlikely to hold water except during the rains.

Rainfall totalled only 23.75 inches, but owing to heavy falls at the end of the season, the water supplies held out well. Nevertheless, natural supplies gave out in October and game concentrated on those pans assisted by supplies from windmills. In spite of this it was obvious that the windmills were not supplying sufficient water to meet the demand, and if drought conditions had commenced earlier or been prolonged a serious position would have arisen.

GAME.

Buffalo have been more widespread. Calves were born in July and August and some herds have increased by as much as 20 per cent.

Eland were noted in large numbers, and in spite of many casualties owing to lions and wild dogs, a large percentage of calves will survive.

Elephants have wandered less than usual and continue to increase. It is noted that the bulls appear to be less shy of tourists and cars than the cows.

Oryx have calved satisfactorily.

Giraffe have been seen less frequently, and it seems possible that there has been a migration westwards.

Impala have suffered severely from lions and wild dogs.

Koodoo appear to have partially abandoned their old haunts for the sandveld, where they have raised a good number of calves.

Klipspringer are still scarce and *Ostriches* appear to have lost all last year's chicks.

Sable and *Roan* antelope have shown a marked increase and a large number of calves have been raised.

With more permanent water supplies *Warthog* have increased considerably and large litters have been raised. *Waterbuck* are still very scarce but have been seen further afield, while *Wildebeeste* show no appreciable change in numbers.

More *Zebra* have been seen than is usual, but like Sable and Roan antelope they appear to have migrated when water supplies diminished in September.

Lions do not appear to have increased to any extent, but wild dogs have been troublesome, more especially among Eland, Koodoo and Impala herds.

Two raiding elephants were destroyed by the Game Warden in the Lukosi area outside the Reserve. These animals had developed a taste for Kaffir corn which, on fermenting in their stomachs, appears to have all the usual effects of native beer, both animals having been found lying down fast asleep.

Victoria Falls Reserve.—As already noted, the death occurred in October of the Curator of the Reserve, Captain J. J. Reynard, who during his tenure of the post did so much to popularise the area and to make the visits of tourists interesting.

Captain A. E. Beechey has now been appointed Acting Curator.

As foreshadowed last year, funds have been provided for the construction of a suitable native compound for immigrant labour. This will be situated at a considerable distance from the Falls and will much improve the amenities of the settlement.

It is possible that funds will also be provided for rest huts for tourists who are unable to afford the facilities provided by the hotel.

An increasingly large number of tourists continues to visit the Falls.

Owing to the cessation of timber exploitation a few years ago, game is increasing and herds of sable and koodoo can frequently be seen on the golf course.

Considerable work has been carried out, more especially by the Railway authorities, with a view to reducing the incidence of malaria, and the toll for this disease is now comparatively negligible.

The road constructed last year along the river bank has proved of great interest.

Rhodes Inyanga Estate.—The policy of developing this Estate as a National playground appears to be meeting with success.

Large numbers of people have visited the Estate during the year, and these could have been greatly increased had further accommodation been available.

Further small additions have been made to the hotel, and three rest camps, each consisting of three rooms and a kitchen and stove, have been completed and opened. These rest camps are roughly furnished and are proving popular, more especially during the dry weather.

Five hundred and fifty acres adjoining the Pungwe Falls were added to the Estate during the year by purchase, thus giving effect to Mr. Rhodes's original desire that the Pungwe Falls should be included in the Estate.

The road system continues to be improved and extended. The Circular Drive, to which alterations and repairs have been carried out by means of a grant made to the Roads Department, is now in good condition. It has nevertheless been decided to close the road during the wet season, partly as a protection against undue damage and partly because the conditions sometimes encountered are so unfamiliar to the average motorist at this time of the year.

A new road connecting the Inyanga village road with the Circular Drive was completed and another commenced to the Nyamziwa Falls.

Experimental planting of timber trees continued, but losses were somewhat severe owing to the long period of drought experienced.

Natural reproduction in plantations of exotic trees was again noticed. In addition to those species noted in previous years must be recorded *Acacia melanoxylon* and *Cupressus lawsoniana*, of which there is one good specimen on the Estate.

The experimental plantings of berry fruits have been continued.

It is as yet too early to draw any conclusions from these experiments, but loganberries appear to be thriving, while black currants and the Fondeleino and Mission Marvel varieties of strawberries are doing well.

Red currants show very poor growth. A satisfactory apple crop was taken by the lessee of the orchards, but owing to drought and hailstorm the coming crop is expected to be a light one.

The year has been an unfortunate one in that large areas have been swept by fires. It is regrettable that these have been caused by European visitors as well as by natives. Four acres of *Pinus radiata* were destroyed.

Outlying portions of the Estate were let to various tenants for farming and other purposes.

Fish.—The trout fishing in the Inyangombie was opened on November 1st. The average weight of fish taken was 1½ lbs., but several fish have been taken in the neighbourhood of 5 lbs., and the record to date is 7¼ lbs. There has been much speculation as to whether such fish are cannibals, but no evidence of this has yet been found and all fish are taken on artificial fly.

Approximately 20,000 fry of Rainbow Trout were released in February. A further 30,000 ova were purchased during the year and the fry will be released later into the headwaters of the smaller streams.

Up to the present the conditions for fishing have not been very satisfactory owing to the lack of early rains, but there

can be no doubt that the fish have grown with astonishing rapidity (the first introduction being less than four years ago), and that they have spawned satisfactorily.

Rainfall.—The rainfall recorded at the various stations during the year was as follows—:

Mtao Forest Reserve (two stations), 22.77 in., 21.82 in.
Stapleford Forest Reserve (three stations), 58.70 in., 54.62 in., 49.49 in.
Salisbury Forest Nursery, 32.40 in.
Gwaai Forest Reserve, 19.43 in.
Rhodes Inyanga Estate, 31.93 in.

Publications.—The following articles prepared by this Division were published in the *Rhodesia Agricultural Journal*:—

"17th Annual Report of Division of Forestry, 1936."

"Veld Fires, the Forest and Herbage Preservation Act, 1936," by E. J. Kelly-Edwards, M.A., Dip For. (Oxon.), Conservator of Forests. Reprinted.

"The Raising of Forest Seedlings and Plants on the Farm," by E. J. Kelly-Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.

"Price List of Forest Trees and Transplants."

An article was contributed by Mr. R. H. Finlay, B.A. (Oxon.) to the Show Number of the *Rhodesia Herald*, and a transcript of this officer's broadcast talk on "Conservation of timber and tree planting on Tobacco Farms" was also published in the Press.

The writer has again the pleasure of recording the loyal co-operation of the staff.

Rhodesia Weather Bureau.

MAY, 1938.

Pressure.—Barometer pressure over Southern Rhodesia was a millibar or more below normal over the whole country.

Temperature.—Both maximum and minimum temperatures were in excess in Matabeleland and the South, and maximum temperatures were high in the North and East, but minimum temperatures were about normal.

Rainfall.—The usual rains were recorded during the month.

PRECIPITATION.

Station.	Inches.	Normal.	No. of Days.
Beitbridge...	0.10	0.36	2
Bindura	0.00	0.50	—
Bulawayo	0.00	0.35	—
Chipinga	0.19	1.00	3
Enkeldoorn...	0.00	0.32	—
Fort Victoria	0.17	0.33	2
Gwaai Siding	0.00	0.12	—
Gwanda	0.00	0.31	—
Gwelo	0.00	0.30	—
Hartley	0.02	0.26	1
Inyanga	0.24	0.50	1
Marandellas	0.14	0.62	1
Miami	0.00	0.04	—
Mount Darwin	0.00	0.45	—
Mount Nuza	0.80	1.55	3
Mtoko	0.00	0.34	—
New Year's Gift	0.79	0.43	4
Nuanetsi	0.01	0.27	1
Plumtree	0.00	0.69	—
Que Que	0.00	0.24	—
Rusape	0.07	0.35	3

Station.	Inches.	Normal.	No. of Days.
Salisbury	0.01	0.47	1
Shabani...	0.13	0.45	2
Sinoia	0.20	0.35	3
Sipolilo	0.00	0.34	—
Stapleford...	0.87	1.40	4
Umtali...	0.10	0.51	3
Victoria Falls...	0.00	0.42	—
Wankie	0.04	0.32	3
Abercorn	0.07	—	1
Balovale	0.00	—	—
Broken Hill...	0.00	—	—
Fort Jameson...	0.00	—	—
Fort Roseberry	0.00	—	—
Isoka	0.05	—	1
Kalomo	1.36	—	5
Kanchindu	0.00	—	—
Kapiri Mposhi	0.00	—	—
Kasama	0.01	—	1
Kasempa	0.00	—	—
Livingstone	0.00	—	—
Lundazi	0.09	—	1
Lusaka...	0.19	—	1
Mankoya	0.00	—	—
Mazabuka	0.75	—	1
Mkushi	0.00	—	—
Mongu	0.00	—	—
Mpika	0.00	—	—
Mporokoso	0.38	—	2
Mufilira	0.00	—	—
Mumbwa	0.03	—	1
Mwinilunga	0.00	—	—
Namwala	0.00	—	—
Ndola	0.00	—	—
Petauke	0.53	—	2
Senanga	0.00	—	—
Sesheke...	0.00	—	—
Solwezi	3.01	—	6

MAY, 1938

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	8-30 a.m. Wet Bulb.	8-30 a.m. Dew Point	8-30 a.m. Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Beitbridge...	1,500	64.9	58.6	54	6.7	81.6	54.0	67.8	92	11	42	18	10	...	1	...	67.4	967.4	883.9	...	2.1	...
Bindura...	3,700	51.9	55.0	49	6.9	77.6	49.1	63.3	85	11	41	20	...	...	...	...	63.8	894.6	884.3	...	1.5	...
Bulawayo	4,393	62.3	52.8	44	9.2	76.7	50.7	63.7	86	11	41	18	1	4	...	...	63.1	871.8	883.4	..	1.7	10.2
Chipinga	3,685	65.2	57.3	51	8.4	74.6	53.1	63.8	84	11	46	18	...	6	...	...	62.6	895.3	884.6	...	3.4	...
Enkeldoorn	4,788	61.3	53.3	47	7.8	74.6	49.4	62.0	82	11	42	20	...	6	...	...	61.2	859.6	883.5	...	1.5	...
Fort Victoria... ...	3,571	63.0	55.2	49	7.9	77.5	48.7	63.1	86	11	39	20	1	3	...	1	63.0	898.2	883.9	...	2.1	...
Gwaai Siding... ...	3,278	60.6	53.1	47	7.3	84.4	45.9	65.2	92	13	36	18	13	...	...	5	...	906.7	882.9	...	1.3	...
Gwanda...	3,233	64.2	55.5	48	7.9	78.9	52.9	65.9	88	11	42	31	4	1	...	...	66.2	908.9	883.8	...	1.4	...
Gwelo	4,629	62.0	53.1	45	7.7	75.5	49.3	62.4	82	11	42	20	...	5	...	...	61.7	864.6	883.5	...	1.4	...
Hartley...	3,879	62.0	54.1	47	7.8	78.8	47.0	62.9	85	11	40	21	...	...	...	...	63.3	887.9	883.3	...	1.0	...
Inyanga...	5,503	61.8	53.0	45	8.4	72.5	45.3	58.9	78	16	38	21	...	6	...	1	57.7	...	...	...	0.8	...
Marandellas	5,453	59.5	51.9	45	7.1	71.5	49.4	60.5	78	11	40	20	...	7	...	...	58.3	...	...	...	0.9	...
Miami	4,090	63.8	55.8	49	8.0	76.6	50.7	63.6	83	17	45	20	...	1	...	...	63.2	881.0	883.0	...	1.1	...
Mt. Darwin	3,179	64.3	57.5	52	7.1	79.1	48.1	63.6	87	11	41	20	3	1	...	...	63.3	...	...	...	2.5	...
Mount Nuza	6,668	53.1	48.0	43	4.4	66.8	46.9	53.8	72	17	39	19	...	28	...	1	51.6	802.9	883.3	...	4.1	...
Mtoko	4,141	63.4	55.6	49	7.9	73.2	52.7	63.0	79	17	47	19	...	5	...	...	63.1	880.2	883.9	...	0.9	..
New Year's Gift...	2,690	62.5	57.8	54	4.9	80.3	51.0	65.7	89	var	43	19	5	1	...	...	...	...	...	...	...	9.1
Nuanetsi	1,581	64.9	58.7	54	6.7	84.5	49.7	67.1	94	11	37	18	11	...	...	4	...	965.3	883.8	...	2.7	...

MAY, 1938 (continued)

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	8-30 a.m. Wet Bulb.	8-30 a.m. Dew Point	8-30 a.m. Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
umtree	4,549	64.7	53.5	44	11.3	76.5	53.2	64.8	83	var.	41	18	...	3	...	...	65.1	866.3	882.7	...	0.9	...
ıe Que	3,999	62.1	54.1	47	7.8	79.7	49.4	64.5	86	10	41	20	1	...	...	...	63.1	884.4	883.6	...	0.6	...
ısape	4,648	59.7	53.5	48	6.0	74.6	46.5	60.5	83	11	37	20	...	6	..	2	60.4	..	...	...	1.4	...
lisbury	4,831	62.2	53.8	47	8.1	75.2	48.5	61.9	81	11	40	20	...	2	...	...	61.1	858.4	883.4	857.1	0.9	9.8
abani	3,131	65.7	56.1	49	10.0	79.1	53.0	66.0	89	11	43	20	7	1	...	...	...	...	...	...	2.1	...
ıoia	3,795	62.9	55.3	49	7.6	80.9	45.5	63.2	87	11	39	21	2	...	...	2	62.3	...	...	...	0.9	...
›olilo	3,876	55.8	56.6	49	9.8	77.3	49.2	63.2	82	16	43	20	...	1	...	...	...	...	...	...	1.0	...
ıpleford	5,304	56.3	52.9	50	3.1	65.8	41.4	53.6	75	11	33	21	...	23	...	13	51.9	844.1	883.7	...	2.7	...
ntali	3,672	63.4	57.4	53	6.3	77.2	51.3	64.3	86	16	45	20	1	2	...	...	61.7	895.5	884.4	894.8	2.3	9.0
ctoria Falls... ...	3,009	66.8	57.0	49	10.4	87.5	52.0	69.7	96	10	43	21	18	...	...	...	69.7	914.1	882.6	...	1.1	...
ankie...	2,567	67.9	57.0	49	11.6	88.7	57.7	73.2	96	9	51	21	...	...	...	...	73.9	929.5	882.8	...	0.6	...
›ercorn	5,407	64.0	59.3	56	5.0	75.9	55.9	65.9	80	17	51	13	...	...	...	...	...	838.3	881.5	...	2.5	...
oken Hill	3,920	63.1	55.9	50	7.3	79.6	51.6	65.6	85	17	46	15	...	...	...	...	...	885.9	882.1	...	1.5	...
.ipili	3,900	60.9	57.5	55	3.5	83.5	53.9	68.7	86	3	48	10	1	...	...	...	...	...	...	...	...	...
rt Jameson ...	3,620	68.0	60.8	56	7.9	83.0	58.0	70.5	90	17	54	20	8	1	...	...	...	889.5	883.1	...	1.0	...
.sama...	4,700	65.7	59.2	55	7.0	78.2	55.1	66.6	82	2	50	12	...	...	...	...	...	865.2	882.0	...	...	...
:sempa	4,500	60.8	55.8	52	5.0	79.1	46.8	62.9	82	2	39	15	...	...	...	1	...	...	...	...	...	...
vingstone	3,140	62.9	54.7	48	8.1	86.4	51.9	69.1	93	11	43	19	15	...	...	...	...	909.0	882.4	...	1.3	...
ızabuka Res. ...	3,385	65.8	56.7	50	9.6	82.1	56.7	69.4	88	11	51	15	...	...	...	...	...	902.2	882.0	...	0.6	...
ıngu	3,475	65.9	57.7	51	8.6	86.1	57.9	72.0	90	13	45	19	16	...	1	...	...	898.6	881.3	...	1.4	...
›ika	4,625	63.1	56.5	51	6.8	75.6	53.6	64.6	81	17	46	12	...	...	...	...	...	863.6	882.3	...	2.6	...
vinilunga	4,450	60.5	56.6	54	3.9	80.3	50.7	65.5	81	2	46	17	...	...	...	...	...	...	...	...	...	...
lola	4,140	61.8	56.3	52	5.6	79.8	49.9	64.9	83	2	45	14	...	...	...	...	...	877.1	882.1	...	1.5	...

Southern Rhodesia Veterinary Report.

APRIL, 1938.

DISEASES.

No fresh outbreaks of scheduled diseases.

TUBERCULIN TEST.

Fifteen bulls, 3 cows and 5 heifers were tested upon importation with negative results.

Fifty-eight cows at Leachdale farm, Shangani, were tested, of which five head gave suspicious reactions. Arrangements are being made to test the entire herd.

Twenty cows on Coldstream Ranch, Makoni, were tested with negative results.

MALLEIN TEST.

Twenty-seven horses and 12 mules were tested. No reactions.

IMPORTATIONS.

From Union of South Africa.—Bulls 33, cows 8, horses 10, mules 12, sheep 801, pigs 3.

From Bechuanaland Protectorate.—Sheep 883.

EXPORTATIONS.

To Union of South Africa.—Oxen 115, cows 148.

To Northern Rhodesia.—Sheep 42.

To Portuguese East Africa.—Cows 91.

To Congo Belge.—Bulls 94, cows 73, oxen 139, horses 17.

EXPORTATIONS—MISCELLANEOUS.

To United Kingdom.—Chilled beef quarters, 9,005; frozen boned beef quarters, 3,987; frozen beef sides, 62; kidneys, 209lbs.; tongues, 9,390lbs.; livers, 21,234lbs.; hearts, 9,693lbs.; tails, 2,997lbs.; skirts, 2,710lbs.; shanks, 10,204lbs.

To Northern Rhodesia in Cold Storage.—Beef carcases, $28\frac{1}{2}$; pig carcases, 81.

To Congo Belge in Cold Storage.—Beef carcases $499\frac{1}{2}$; mutton carcases, 30; veal carcases, 40.

Meat Products.—From Liebig's Factory:

To. Union of South Africa.—Corned beef, 191,328lbs.; meat extract, 19,497lbs.; beef powder, 9,777lbs.; beef fat, 24,000lbs.; premier jus, 25,131lbs.; hooves, 29,283lbs.

G. C. HOOPER SHARPE,
Chief Veterinary Surgeon.

Departmental Bulletins.

The following Bulletins are available for distribution at 3d. per copy. Application should be made to the Editor, Department of Agriculture, Salisbury, and remittances must accompany orders.

N.B.—The date the article appeared in the Journal is indicated in abbreviated form before the number, e.g., 8/22, No. 429, means that Bulletin 429 appeared in the Journal for August, 1922.

AGRICULTURE AND CROPS.

3/31. No. 815. New Strains of Oats for Southern Rhodesia, by H. C. Arnold, Manager, Agricultural Experiment Station, Salisbury.

4/31. No 816. Preliminary List of the more Common Grasses of Southern Rhodesia, by Sydney M. Stent, Botanist for Pasture Research.

5/31. No. 822. Re-stacking of Maize rejected for Export on account of Excessive Moisture.

9/31. No. 826. Some Poisonous Plants of Southern Rhodesia, by Sydney M. Stent, Senior Botanist.

10/31. No. 831. Revised Notes on Cotton Growing in Southern Rhodesia, by G. S. Cameron.

11/31. No. 836. The Potato, by S. D. Timson, M.C., Dip.Agric. (Wye).

12/31. No. 837. Veld Grass Silage: A Feature in Rhodesian Pasture Management, by H. G. Mundy, Dip.Agric. (Wye), F.L.S., Chief, Division of Plant Industry.

6/32. No. 855. Pigeon-hole Method of Stacking Maize, by Division of Plant Industry.

8/32. No. 859. Twenty-one Years of Plant Introduction, by Major Mundy, Chief Division of Plant Industry.

2/33. No. 878. A.I.V. Silage: Memorandum prepared and circulated by Imperial Bureau of Animal Nutrition.

11/34. No. 936. Witchweed, by S. D. Timson, M.C. Dip.Agric. (Wye), Assistant Agriculturist.

10/35. No. 970. Rhodes Grass for the Southern Rhodesian Tobacco Grower, by African Explosives and Industries, Ltd.

11/35. No. 972. Notes on Witchweed, by S. D. Timson, M.C., Dip.Agric. (Wye), Assistant Agriculturist.

6/36. No. 992. Annual Report of the Agriculturist for the year 1935, by D. E. McLoughlin, Agriculturist.

7/36. No. 994. Some Notes on Cotton Growing, by J. E. Peat, Senior Plant Breeder, Cotton Station, Gatooma.

4/37. No. 1022. Smut Diseases of Wheat in Southern Rhodesia, by G. M. Wickens, B.Sc. Agric., Ph.D., D.I.C., Plant Pathologist, Tobacco Research Station, Trelawney.

10/37. No. 1046. Green Manuring: Two Important Factors Affecting Success, by S. D. Timson, M.C., Assistant Agriculturist, and H. C. Arnold, Manager, The Agricultural Experiment Station.

REPORTS ON CROP EXPERIMENTS.

7/27. No. 649. Annual Report of Experiments, 1925-26, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Manager.

4/28. No. 683. Annual Report of Experiments, 1926-27, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Station Manager.

7/29. No. 745. Salisbury Agricultural Experiment Station Annual Report, 1927-28, by H. C. Arnold.

7/30. No. 789. Agricultural Experiment Station, Salisbury. Annual Report of Experiments, 1928-29, by H. C. Arnold.

9/31. No. 830. Salisbury Agricultural Experiment Station, Annual Report, 1929-30, by H. C. Arnold, Manager.

10/32. No. 864. Annual Report, 1930-31: Agricultural Experiment Station, by H. C. Arnold, Station Manager.

6/33. No. 895. Salisbury Agricultural Experiment Station Annual Report, 1931-32, by H. C. Arnold, Manager.

3/34. No. 914. Gwelo Municipal Demonstration Station: Final Report, 1933, by S. D. Timson, M.C., Dip.Agric. (Wye), Assistant Agriculturist.

9/35. No 965. Salisbury Agricultural Experiment Station Annual Report, 1933-34, by H. C. Arnold, Manager.

TOBACCO.

8/26. No. 605. Flue-curing Tobacco Barns, Bulking and Grading Sheds, by P. H. Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.

9/26. No. 615. The Culture of Virginia Tobacco in Southern Rhodesia: Field Management, by D. D. Brown.

5/27. No. 641. The Handling, Grading and Baling of Cured Virginia Tobacco, by D. D. Brown.

5/27. No. 644. Tobacco Baling Boxes, by B. G. Gundry, Irrigation Branch.

9/27. No. 653. The Care of Tobacco Seed Beds, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad)

11/27. No. 661. Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16 ft., by B. G. Gundry.

1/28. No. 665. Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.

2/28. No. 671. Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.

12/28. No. 715. Turkish Tobacco Culture in Southern Rhodesia, by D. D. Brown, Chief Tobacco Expert.

3/29. No. 728. Suggested Crop Rotations for Tobacco Growers, by D. D. Brown, Chief Tobacco Expert.

4/29. No. 734. Common Faults in Curing Virginia Bright Tobacco, by D. D. Brown, Tobacco and Cotton Expert.

8/29. No. 748. Frog Eye Disease of Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

9/29. No. 753. Leaf Spotting of Tobacco caused by Mosaic, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

2/30. No. 771. Dark Fire-cured Tobacco: Field Operations, by D. D. Brown, Chief Tobacco Expert.

3/30. No. 774. Dark Fire-cured Tobacco: Harvesting and Curing, by D. D. Brown, Chief Tobacco Expert.

6/30. No. 784. Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.

3/31. No. 812. Selection of Tobacco Seed Plants, by H. F. Ellis, M.Sc., B.S. (Agric.), Tobacco Adviser.

11/31. No. 835. Tobacco Culture: Transplanting Operations, by D. D. Brown.

3/32. No. 846. Leaf Curl in Tobacco, by Dr. H. H. Storey.

3/33. No. 885. Tobacco Culture in Southern Rhodesia: The Harvesting and Curing of Virginia Tobacco, by D. D. Brown, Chief Tobacco Officer.

8/36. No. 996. The "Gundry" Tobacco Furnace, by B. G. Gundry, A.I.Mech.E.

12/36. No. 1009. Tobacco Research on the Trelawney Station 1935-36 Season.

4/37. No. 1025. Report of the Tobacco Research Board, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture and Chairman of the Tobacco Research Board.

5/37. No. 1026. Notes on Tobacco Root-Knot Nematode, by J. C. Collins, B.Sc., Biologist, Trelawney Tobacco Research Station.

8/37. No. 1039. Some Tobacco Pests that can be serious, by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.

1/38. No. 1054. Alkalinity of Tobacco Seed-bed Soils, by A. P. Taylor, M.A., B.Sc., Agricultural Chemist.

3/38. No. 1063. A New and Serious Disease of Tobacco in Southern Rhodesia, by G. M. Wickens, Ph.D., D.I.C., Plant Pathologist, Tobacco Research Station, Trelawney.

5/38. No. 1070. A Witchweed on Tobacco Roots (*Striga orobanchoides*, Benth.), by Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

6/38. No. 1072. Report of the Tobacco Research Board for the year ending 31st December, 1937, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture, and Chairman of the Tobacco Research Board.

LIVE STOCK.

1/27. No. 624. The Construction of Dipping Tanks for Cattle (Revised).

1/31. No. 801. Sheep Farming in the Melsetter District, by J. C. Kruger, Part-time Sheep Adviser in the Melsetter District.

10/32. No. 863. Piggeries, by B. G. Gundry, A.I.Mech.E.

12/32. No. 871. Some General Observations on the Feeding of Dairy Cows on a Mixed Stock Farm, by Dr. A. E. Romyn, Senior Animal Husbandry Officer.

4/33. No. 887. The Type of Chiller Steer required for Export, by A. E. Romyn, Senior Animal Husbandry Officer.

9/33. No. 903. The Handling, Preparation and Chilling of Cattle for Export, by C. A. Murray, Lecturer in Animal Husbandry.

12/33. No. 907. The Blackhead Persian: Its Breeding and Management in Matabeleland, by C. A. Murray, M.Sc., Lecturer in in Animal Husbandry, Matopo Estate.

1/34. No. 909. Stall Fed Chillers for the Overseas Christmas Market, by C. A. Murray, M.Sc., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.

2/34. No. 912. Economical Winter Rations for Wintering Dairy Heifers, by C. A. Murray, M.Sc. (Agric), Lecturer in Animal Husbandry, Matopo School of Agriculture.

4/34. No. 916. Cowpea Hay in the Ration for Bacon Pigs, by C. A. Murray, M.Sc. (Agric.), Lecturer in Animal Husbandry, Matopo School of Agriculture and Experiment Station.

6/34. No. 924. Raising Dairy Calves on a Limited Amount of Whole Milk, by C. A. Murray, M.Sc., Agr., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.

1/35. No. 943. Cattle Improvement and a Cattle Breeding Policy in Southern Rhodesia: A Review of the General Position Chiefly as regards Ranching Cattle, by Dr. A. E. Romyn, Chief Animal Husbandry Officer.

1/35. No. 945. A Home-made Cow Stanchion, by Major R. R. Sharp, Whinburn, Redbank.

3/35. No. 946. Economical Rations for Wintering Dairy Cattle, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station.

5/35. No 952. Annual Report of the Chief Animal Husbandry Officer for the year ending 31st December, 1934, by A. E. Romyn, Chief Animal Husbandry Officer.

7/35. No. 959. The Selection of a Dairy Bull, by A. E. Romyn, Ph.D., Chief Animal Husbandry Officer.

4/36. No. 984. Report on the Curing of Rhodesian Hides, by Advisory Committee on Hides and Skins of the Imperial Institute.

4/36. No 985. Export of Frozen Porkers. Third Consignment to Smithfield. Division of Animal Husbandry.

5/36. No. 987. The Curing of Hides and Skins on the Farm, by The Division of Animal Husbandry.

5/36. No. 988. Preparing Cattle for Show, by The Animal Husbandry Division.

6/36. No. 989. The Supplementary Feeding of Mineral and Protein Supplements to Growing Cattle in Southern Rhodesia and its Relation to the Production of Beef Steers, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E. Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Southern Rhodesia; D. G. Haylett, Ph.D., Director, Rhodes Matopo Estate; F. Ericksen, Dip. Agric., Experimentalist.

10/36. No. 1001. The Raising of Bacon Pigs, by A. E. Romyn, Chief Animal Husbandry Officer, and C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate, with a Veterinary Section by D. A. Lawrence, Director of Veterinary Research.

9/36. No. 1000. Sheep Management on the Mixed Farm, by R. H. Fitt, Animal Husbandry Officer.

4/37. No. 1023. Cowpea Molasses Silage for Fattening Steers, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station; A. E. Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Salisbury; R. H. Fitt, Dipl. Agric., Animal Husbandry Officer, Department of Agriculture, Salisbury.

4/37. N. 1024. Comparative Feeding Value of Maize Meal and Nyouti (*Pennisetum Typhoides*) Meal for Fattening Steers, by C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E. Romyn, Chief Animal Husbandry Officer.

5/37. No. 1027. The Feeding of Phosphorus Supplements to Growing Cattle, by C. A. Murray and A. E. Romyn.

5/37. No. 1029. The Dehorning of Cattle intended for Slaughter and Export, by B. A. Myhill, Assistant Chief Veterinary Surgeon.

5/37. No. 1030. The Feeding of Different Winter Supplements to young growing steers and the effect of these supplements on the subsequent development and costs of production of the steers, by C. A. Murray and A. E. Romyn.

6/37. No. 1032. The Effects of Feed on the Firmness and Grading of Bacon Carcases, an experiment carried out by the Division of Animal Husbandry in co-operation with Mr. A. L. Millar, Estes Park, Salisbury, and Mr. Frank Neill, of Neill's Bacon Factory, Salisbury.

6/37. No. 1034. Nyouti or Munga (*Pennisetum typhoides*) as a Feed for Bacon Pigs, by C. A. Murray and A. E. Romyn.

7/37. No. 1036. Preliminary Report on the Feeding of Winter Supplements to young growing steers and the effect of supplementary feeding on the subsequent development of these animals, by C. A. Murray and A. E. Romyn.

12/37. No. 1049. The Export of Frozen Porkers: Report on Five Consignments of Porkers Exported to Smithfield, by Division of Animal Husbandry.

1/38. No. 1053. The Feeding of Sunnhemp Hay as compared with Cowpea Hay in the Fattening Ration for Bullocks, by A. E. Romyn and R. H. Fitt.

2/38. No. 1058. Pig Industry Act, 1937. Division of Animal Husbandry.

3./38. No. 1062. Protein Supplements for Fattening Bullocks, by A. E. Romyn and R. H. Fitt.

DAIRYING.

12/30. No. 799. The Objects of Ripening Cream for Butter-making, and a few Hints on Cream Production, by F. Lammas, Dairy Officer.

4/31. No. 818. Farm Butter-making. Issued by the Dairy Branch.

9/32. No. 862. Cream Cheese, by F. A. Lammas, Dairy Officer.

3/33. No. 880. Dairy Tests and Calculations, by F. A. Lammas, Dairy Officer.

5/34. No. 922. Dairy Building in Southern Rhodesia: A Small Farm Dairy, by G. B. Gundry, A.I.Mech.E.

7/34. No. 926. Dairy Buildings in Southern Rhodesia. Cow Byre—Type II., by B. G. Gundry, A.I.Mech.E.

12/34. No 937. Gouda or Sweet Milk Cheese, by F. Lammas, District Dairy Officer.

2/36. No. 977. Notes on the Feeding of Dairy Cows during the Summer Months, by A. E. Romyn, Chief Animal Husbandry Officer.

6/36. No. 990. Southern Rhodesia Milk Recording Scheme.

12/37. No. 1051. The Production and Handling of Milk and Cream, by the Dairy Branch.

VETERINARY.

IRRIGATION, WATER SUPPLIES AND SOIL EROSION.

11/28. No. 668. The Water Act, 1927, by C. L. Robertson, B.Sc. (Eng.), A.M.I.C.E.

1/28. No. 670. Irrigation Canals, by P. H. Haviland, B.Sc. (Eng.).

6/30. No. 786. Low Concrete Dams, by R. Hamilton Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

2/31. No. 808. The Application of Water in Irrigation, by R. Hamilton Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

3/31. No 811. Irrigation Canal Structures, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

8/32. No. 860. Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

2/33. No. 879. Conditions Governing the Hire of Government Boring Machines.

8/33. No. 900. Three Types of Water Tank, by R. H. Roberts, B.Sc. (Eng.), A.M.I.C.E., Assistant Irrigation Engineer.

6/35. No. 956. Annual Report of the Division of Irrigation for the year ended 31st December, 1934, by P. H. Haviland, B.Sc. (Eng.), Acting Chief Irrigation Engineer.

9/35. No. 964. The Use of Ditchers for Constructing Contour Ridges, by C. Tapson, Devondale, Concession.

9/35. No. 967. How to use an Engineer's or Farm Level, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E., Irrigation Engineer (Matabeleland).

12/35. No 973. Domestic Water Supplies and Sanitation on the Farm, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E.. Irrigation Engineer (Matabeleland).

3/36. No. 980. Results from Glenara Soil Conservation Experiment Station, 1934-35 Season, by C. L. Robertson, B.Sc. A.M.I.C.E., Chief Engineer, Irrigation Division, and A. D. Husband, F.I.C., Chief Chemist.

8/36. No. 999. Lining an Irrigation Furrow, by R. H. Roberts, B.S.. A.M.Inst.C.E., Assistant Irrigation Engineer.

3/37. No. 1019. Soil Conservation, by D. Aylen, Esq., Outside Technical Assistant, and R. Hamilton Roberts, B.Sc., A.M.Iinst.C.E., Irrigation Engineer.

1/38. No. 1052 Small Earthen Storage Dams. Part I. By the Irrigation Division.

2/38. No. 1055. Small Earthen Storage Dams. Part II. By the Irrigation Division.

3/38. No. 1061. Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

FORESTRY.

11/29. No 763. The Utilisation of Wood, by T. L. Wilkinson, M.Sc., B.Sc.F.

1/30. No. 769. The Utilisation of Wood, by T. L. Wilkinson, M.Sc., B.Sc.F.

4/30. No. 778. The Utilisation of Wood in Southern Rhodesia—Conversion and Disposal of Timber, by T. L. Wilkinson, M.Sc., B.Sc.F., District Forest Officer.

8/30. No. 791. The Utilisation of Wood in Southern Rhodesia: Fencing, by T. L. Wilkinson, M.Sc., B.Sc.F., District Forest Officer.

2/31. No. 809. Establishing Pines: Preliminary Observations on the Effects of Soil Inoculation. Issued by the Division of Forestry.

4/31. No. 817. The Raising of Forest Seedlings and Transplants on the Farm, by E. J. Kelly Edwards, M.A., Dip.For. (Oxon.), Acting Chief Forest Officer.

7/32. No. 857. Charcoal Burning on the Farm, by R. J. Allen, Forester, Rhodes Matopo School of Agriculture and Experiment Station.

11/32. No 869. Wind-breaks and Shelter Belts, by A. A. Pardy, B.Sc., Forestry.

1/33. No. 874. Tree Planting, by the Division of Forestry.

4/33. No. 888. The Vegetable Ivory Palm (Hyphoene ventricosa), by G. M. McGregor, B.Sc., District Forest Officer, Matabeleland.

8/34. No. 927. Some Facts about Tung Oil, by R. H. Finlay, B.A., Dip. For. (Oxon.), District Forest Officer.

8/34. No. 928. Some Trees, Shrubs, Shrubby-Herbaceous Plants, Climbers and Water Plants suitable for the Colony, by J. W. Barnes, Manager, Government Forest Nursery, Salisbury.

12/35. No. 974. Summary of the Annual Report of the Division of Forestry for the year 1934, by E. J. Kelly-Edwards, M.A., Dip. For. (Oxon.), Chief Forest Officer.
Price List of Forest-tree Transplants, Ornamental Trees Shrubs, Hedge Plants, Creepers and Seeds obtainable at the Government Forest Nursery, Salisbury.

3/37. No. 1020. The Raising of Forest Seedlings and Transplants on the Farm, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.

10/37. No. 1045. Seventeenth Annual Report of the Division of Forestry for the Year 1936, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.

6/38. No. 1073. Pruning of Plantations. by R. H. Finlay, B.A., Oxon., Division of Forestry.

HORTICULTURE

4/27. No. 637. Harvesting, Packing and Marketing of Deciduous and Tropical Fruits, by G. W. Marshall, Horticulturist.

8/27. No. 650. Coffee Culture in Southern Rhodesia, by G. W. Marshall, Horticulturist.

2/29. No. 725. Investigations into "Collar-Rot" Disease of Citrus, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad)

3/31. No. 814. Avocado Growing in South Africa, by Redvers J. Blatt, B.Sc., Ph.D.

11/31. No. 834. Celery Culture, by G. W. Marshall, Horticulturist.

1/32. No. 843. Vegetable Growing in Southern Rhodesia: Onion Culture, by G. W. Marshall, Horticulturist.

2/33. No. 876. Notes on African Aloes (Parts 1-6), by H. Basil Christian, "Ewanrigg," Arcturus.

10/33. No. 905. Notes on African Aloes (Parts 7-10), by H. Basil Christian "Ewanrigg," Arcturus

5/34. No. 920. Citrus Fruit Growing in Rhodesia, by G. W. Marshall, Horticulturist.

5/37. No. 1028. Tomato Culture in Southern Rhodesia, by G. W. Marshall, Horticulturist.

9/37. No. 1043. The Rhodesian Home Orchard, by G. W. Marshall, Horticulturist.

ENTOMOLOGY AND PLANT PATHOLOGY.

2/13. No. 139. Termites, or "White Ants," by Rupert W. Jack, F.E.S

6/15. No. 214. Some Household Insects, by R. Lowe Thompson, B.A.

2/21. No 385. The Common Fruit Beetle, by R. W. Jack, F.E.S.

12/24. No. 522 Notes on the Black Citrus Aphis, by C. B. Symes.

8/25. No. 548. Insect Pests of Cotton, by C. B. Symes.

9/27. No. 653. The Care of Tobacco Seed Beds, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad).

1/28. No. 665. Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.

2/28. No. 671. Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.

6/28. No. 696. Ticks Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.

11/28. No. 714. Trap Cropping against Maize Pests, by Rupert W. Jack, F.E.S., Chief Entomologist.

12/28. No. 718. Preliminary Experiments on the Control of White Mould of Tobacco, by J. C. F. Hopkins, B.S. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

3/29. No. 732. Two Common Diseases of Potato Tubers in Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.

6/29 No. 742. What is Diplodia in Maize? An Answer to a Popular Question To-day, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

8/29. No. 748. Frog Eye Disease of Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

9/29. No. 753. Leaf Spotting of Tobacco caused by Mosaic, by J. C. F. Hopkins, B.Sc (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

9/29. No. 754. "Pinking" of Maize: Report of a Preliminary Investigation, by T. K. Sansom, B.Sc., Plant Breeder.

6/30. No. 784. Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.

6/30. No. 788. A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.

A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist. Supplement No. 1.

7/30. No. 790. Notes on the Control of Some of the More Important Insect Pests of Citrus in Southern Rhodesia, by W. J. Hall, Ph.D., B.Sc., Entomologist to the British South Africa Company in Southern Rhodesia.

10/30. No. 796. The Army Worm (Laphygma exempta, Wlk.), by Rupert W. Jack, Chief Entomologist.

11/30. No. 798. The Preparation of Bordeaux Mixture and Seasonal Notes on Tobacco Diseases, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.

1/31. No. 804. Locusts in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.

8/31. No. 825. Some Common Diseases of Potatoes in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), Plant Pathologist.

3/32. No. 848. Mycological Notes: Seasonal Notes on Tobacco Diseases: 3, Frog Eye; 4, White Mould; by J. C. F. Hopkins, B.Sc. (Lond.).

4/32. No. 850. Pests of Stored Tobacco in Southern Rhodesia, by M. C. Mossop, M.Sc., Entomologist.

6/32. No. 856. A List of Plant Diseases occurring in Southern Rhodesia, Supplement 2, by J. C. F. Hopkins, B.Sc. (Lond.), Government Plant Pathologist.

9/32. No. 861. Further Notes on Leaf Curl of Tobacco in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), Plant Pathologist.

11/32. No. 868. Cultural Methods and Tobacco Whitefly in Southern Rhodesia, by M. C. Mossop, M.Sc., Entomologist.

5/33. No. 892. The Tsetse Fly Problem in Southern Rhodesia, by R. W. Jack, Chief Entomologist.

5/33. No. 893. Experiments with Tsetse Fly Traps against Glossina Morsitans in Southern Rhodesia, by R. W. Jack, Chief Entomologist.

6/33. No. 894. Mycological Notes. Seasonal Notes on Tobacco Diseases. 6. An Unusual Type of Frog Eye Spotting, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.

6/33. No. 896. A List of Plant Diseases occuring in Southern Rhodesia. Supplement 3. (New Records for period June, 1932, to May, 1933.) Compiled by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.

7/33. No. 897. The Report of the Chief Entomologist for the year ending 31st December, 1932, by Rupert W. Jack, F.E.S., Chief Entomologist.

8/33. No. 899. The Black Maize Beetle (Heteronchus Licus Klug), by C. B. Symes.

10/33. No. 904. Notes on the Biology and Control of the Red Locust in Southern Rhodesia, 1932-1933. Part I.: Control of Locusts, by R. W. Jack, Chief Entomologist. Part II.: Biological Notes on the Red Locust (Nomadacris septemfasciata, Serv.), by M. C. Mossop, A.F.C., M.Sc., Entomologist.

10/33. No. 906. The Locust Invasion of Southern Rhodesia, 1932-33, by R. W. Jack, Chief Entomologist.

2/34. No. 911. Screw Worm. A Pest of Ranch Cattle in Southern Rhodesia, by A. Cuthbertson, Entomologist. Foreword by R. W. Jack, Chief Entomologist.

3/34. No. 913. Locusts: Instructions for dealing with Flying Swarms, by The Division of Entomology.

4/34. No. 917. The Life History of the Screw-worm Fly, by Alexander Cuthbertson, Entomologist.

10/34. No. 934. Mycological Notes. Seasonal Notes on Tobacco Diseases. 7, Spraying in Seed-beds and Lands, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

12/34.	No. 938.	The Destruction and Control of Locust Hoppers, by R. W. Jack, Chief Entomologist.
1/35.	No. 942.	Mycological Notes. Seasonal Notes on Tobacco Diseases. 8, The Mosaic Mystery. 9, Danger Points in Field Spraying, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
4/35.	No. 950.	The Control of Tsetse Fly in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.
4/35.	No. 951.	Suspected "Streak" Disease of Maize. Notice to Growers, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
6/35.	No. 957.	Annual Report of the Branch of Plant Pathology for the year ending 31st December, 1934, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
8/35.	No. 962.	The Report of the Chief Entomologist for Year ending 31st December, 1934, by R. W. Jack, Chief Entomologist.
10/35.	No. 969.	The Objects and Value of Seed Treatment of Maize against Diplodia, by G. M. Wickens, Ph.D. (Lond.), D.I.C., Assistant Plant Pathologist.
5/36.	No. 986.	Annual Report of the Division of Entomology for year ending 31st December, 1135, by Rupert W. Jack, Chief Entomologist.
7/36.	No. 993.	Annual Report of the Senior Plant Pathologist for year ending 31st December, 1935. Part I.: Plant Pathology. Part II.: Tobacco Research, by J. C. S. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist and Officer in Charge of Tobacco Research Station, Trelawney.
12/36.	No. 1011.	Tick Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist. Revised, November, 1936.
7/37.	No. 1037.	Division of Entomology: Annual Report for year 1936, by R. W. Jack, Chief Entomologist.
8/37.	No. 1040.	A Programme for the Control of Diseases of Apple Trees in Southern Rhodesia, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
10/37.	No. 1047.	Mycological Notes: Seasonal Notes on Tobacco Diseases. X.: Precautionary Methods in Seed-beds, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
12/37.	No. 1050.	An Unusual Winter Outbreak of Maize Weevil *Calandra oryzae*, L.), by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.
2/38.	No. 1059.	A Poison Bait for Young Locust Hoppers.
6/38.	No. 1071.	Common Diseases of Apples and their Control in Southern Rhodesia, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., and Aline L. Bacon, B.Sc., Division of Plant Pathology.
6/38.	No. 1074.	A Note on a Stem Rot of Sweet Peas, by J. C. F. Hopkins, D.Sc., A.I.C.T.A., Senior Plant Pathologist.

POULTRY.

1/29.	No. 721.	Poultry Keeping in Rhodesia: Pedigree Breeding, by H. G. Wheeldon, Assistant Poultry Expert.
4/29.	No. 738.	Hints to Breeders: Rearing Young Stock, by A. Little, Poultry Expert.

6/29. No. 740. Artificial Incubation, Breeding and Rearing of Chicks, by H. G. Wheeldon, Poultry Expert.

11/29. No 761. Housing and Feeding of Adult Stock, by H. G. Wheeldon, Poultry Expert.

10/30. No. 795. The Turkey, by G. H. Cooper, Assistant Poultry Officer

1/31. No. 803. Geese, by G. H. Cooper, Assistant Poultry Officer.

9/31. No. 827. The Ideal Brooder, by F. Roberts, Assistant Poultry Officer.

10/32. No. 865. Poultry Industry: Care of Young Stock in Hot Weather, by H. G. Wheeldon, Chief Poultry Officer.

11/32. No. 870. Trap Nests, by B. G. Gundry, A.I.MechE. (combined with No. 875).

3/33. No. 884. The Vitamins in Poultry Feeding, by G. H. Cooper, Poultry Officer, Matopo School of Agriculture and Experiment Station.

5/34. No 918. The Moulting of Poultry: The Normal and Pullet Moult, by H. G. Wheeldon, Poultry Officer.

10/34. No 933. Ducks on the Farm (Revised), by H. G. Wheeldon, Poultry Officer.

12/34. No. 939. The Use of Galvanised Iron in the Making of Some Appliances for Poultry Keeping, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.

12/34. No. 940. A Cheap Portable Colony House for Poultry, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.

3/34. No. 947. Modern Culling of Laying Hens, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.

9/35. No. 966. Egg Marketing Bill: Draft of a Bill having for its purpose the more orderly Marketing of Eggs.

11/35. No. 971. Feeds for Poultry and How to Use Them, by G. H. Cooper, Assistant Poultry Officer.

The following pamphlets can be obtained from the Poultry Officer upon application:—

Selecting Birds for Laying Tests, by A. Little, Poultry Expert.

Tuberculosis, by A. Little, Poultry Expert.

Prevention of Disease among Poultry, by A. Little, Poultry Expert.

Preparing Birds for Show, by A. Little, Poultry Expert.

The Fowl Tick (Argas persicus), by A. Little, Poultry Expert.

Culling: A Seasonal Operation, by A. Little, Poultry Expert.

Choosing a Male Bird, by A. Little, Poultry Expert.

The Breeding Stock, by A. Little, Poultry Expert.

Diseases of the Digestive System, by A. Little, Poultry Expert.

Mating for Improvement and Increased Egg Production, by A. Little, Poultry Expert.

Partial Moult: Broodiness. Selection of Layers of Large Eggs, by A. Little, Poultry Expert.

Exhibiting Eggs at Shows, by A. Little, Poultry Expert.

Condition of Birds on Show, by A. Little, Poultry Expert.

Green Food: The Result of not Supplying Sufficient to Poultry, by A. Little, Poultry Expert.

Good and Bad Hatching Eggs, by A. Little, Poultry Expert.

Grading Fowls, by A. Little, Poultry Expert.

Housing: Three Important Essentials, by A. Little, Poultry Expert.
Advice to Prospective Poultry Farmers, by A. Little, Poultry Expert
Seasonal Hints—August, by A. Little, Poultry Expert.
Successful Chick Rearing, by H. G. Wheeldon, Assistant Poultry Expert.
Hints to Breeders, October, by A. Little, Poultry Expert.
Abnormalities in Eggs, by A. Little, Poultry Expert.
Hints to Breeders. Prepare for the Breeding Season, by A. Little.
Respiratory Diseases, by A. Little, Poultry Expert.
Selection and Preparation of Fowls for Exhibition, by H. G. Wheeldon, Poultry Expert.
The Close of the Hatching Season and After, by H. G. Wheeldon, Poultry Expert.

METEOROLOGICAL.

12/22.	No. 436.	The Possibility of Seasonal Forecasting and Prospects for Rainfall Season, 1922-23, by C. L. Robertson, B.Sc., A.M.I.C.E.
12/24.	No. 524.	The Use of an Aneroid Barometer, by C. L. Robertson, B.Sc., A.M.I.C.E.
2/25.	No. 532.	The Short Period Forecast and Daily Weather Report, by C. L. Robertson, B.Sc., A.M.I.C.E.
6/25.	No. 542.	Review of the Abnormal Rainfall Season, 1924-25, by C. L. Robertson, B.Sc., A.M.I.C.E.
10/28.	No. 712.	The Time, and How to Find It, by N. P. Sellick, M.C., B.Sc. (Eng.).
10/31.	No. 832.	The Weather Map and the Short Period Weather Forecast, issued by the Meteorological Office.
2/33.	No. 877.	Clouds and Weather in Southern Rhodesia, by N. P. Sellick, M.C., B.Sc., Meteorologist.
3/35.	No. 948.	The Weather, contributed by The Meteorological Office.

AGRICULTURAL BUILDINGS.

9/25.	No. 554.	Pisé-de-Terre, by P. B. Aird.
4/26.	No. 588.	Concrete on the Farm, by N. P. Sellick, M.C., B.Sc. (Eng.), Assistant Irrigation Engineer.
8/26.	No. 605.	Flue-curing Tobacco Barns. Bulking and Grading Sheds, by P. H. Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.
5/27.	No. 644.	Tobacco Baling Boxes, by B. G. Gundry, Irrigation Branch.
11/27.	No. 661.	Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16ft., by B. G. Gundry.
10/32.	No. 863.	Piggeries, by B. G. Gundry, A.I.Mech.E.
5/33.	No. 889.	The Construction of Dipping Tanks, by B. G. Gundry, A.I.Mech.E.; and Notes on their Management, by J. M. Sinclair, M.R.C.V.S., Chief Veterinary Surgeon.
9/33.	No. 902.	Brick-making on the Farm, by A. C. Jennings, Assoc.M.Inst.C.E.
12/33.	No. 908.	A Charcoal Safe or Cooler, by B. G. Gundry, A.I.Mech.E., Irrigation Division.

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Chemist.

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NOTICE

The Agricultural Journal of S. Rhodesia

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Agricultural Journal

Edited by the Director of Agriculture.
(Assisted by the Staff of the Agricultural Department).

PUBLISHED MONTHLY.

Subscription: 5/- per annum; payable to the Accountant, Department of Agriculture, Salisbury.

VOL. XXXV.] AUGUST, 1938. [No. 8.

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Treating Tobacco Seed.—Recognising the importance of using properly cleaned and chemically treated tobacco seed, this Department has for the last few years undertaken this service on behalf of the tobacco growers. The fee charged is 6d. per ounce of cleaned seed. The treatment is carried out by the Chemistry Branch, and as provision has to be made to provide this service without undue interference with the other duties of the technical staff, farmers are requested to send in their seed for treatment as early as possible. It should be addressed to the Chief Chemist, Box 387, Salisbury.

Witchweed.—On Friday, the 1st July, the Secretary, Department of Agriculture and Lands, attended, by invitation, a joint meeting of the Concession-Glendale Farmers' Associations. One of the matters which the Associations wished to discuss was a reference made in the Annual Report of the Government Agriculturist for the year 1936—reprinted in the *Rhodesia Agricultural Journal*, December, 1937—in which it was stated that a resolution had been passed by the Concession Farmers' Association condemning the methods recommended by the Department, for the control and eradication of witchweed. The statement was based on the following relevant portion of a report of a monthly meeting of the Concession (Mazoe) Farmers' Association which was brought to the notice of the Department.

> "A resolution was passed calling the attention of the Government to the increasing heavy loss caused to the maize grower and stating that owing to the seriousness of the pest the services of a part-time official of the Agricultural Department were quite inadequate. The resolution also declared that the failure of all methods recommended for the control of witchweed called for fresh and independent research work, particularly on the part of an agricultural chemist."

Commencing in March, 1938, correspondence took place between the Association and the Department, the former stating that no such resolution had been adopted and that the report on which the remarks of the Government Agriculturist had been based did not accurately reflect the general opinion of the Association. In the course of this correspondence it emerged that the following was the resolution actually passed but that inadvertently it had not been communicated to the Department.

> "This meeting asks the Government to establish an experimental plot in this centre for full research into witchweed eradication, with a full-time man in charge."

The Association wished it to be recorded that at no time had they as a body condemned the methods of control and eradication of witchweed recommended by the Department, but they were of opinion that a greater measure of experimen-

tal and demonstrative work in the Mazoe Valley was desirable, in order that the problem of this most serious pest of maize might more adequately be dealt with.

Moisture Content of Export Tobacco.—This Department has been informed officially that there is no legal obstacle to the import into the United Kingdom of tobacco of any desired degree of dryness, provided that the appropriate rate of Customs duty is paid. Tobacco must be entered with the Customs on importation as containing either (*a*) 10 lbs. or more of moisture in every 100 lbs. weight thereof, or (*b*) less than 10 lbs. of moisture in every 100 lbs. weight thereof. Customs duty is payable at a higher rate on tobacco in category (*b*) than on tobacco in category (*a*). If tobacco in category (*b*) is entered by the importer in category (*a*), it is liable, under Section 67 of the Customs Consolidation Act, 1876, to forfeiture, and the importer is liable to a penalty. In that event, however, the Board of Customs and Excise will usually consider admitting the tobacco, provided that duty is paid at the higher rate.

There have been no recent changes in the method of testing tobacco for moisture content. Representative samples are taken by officers of the Board of Customs and Excise and forwarded to the Government Laboratory for test. The tobacco is there dried at a temperature of 212 degrees Fahrenheit and the percentage of moisture is calculated from the decrease in weight. It is thought essential for the protection of the revenue that the Board of Customs and Excise should test imports of tobacco in this way, and in any case a guarantee given by any exporter in Southern Rhodesia could not be accepted as relieving the importer of his statutory obligation to enter the tobacco in the correct category.

The Drug Ephedrine.—The following notes on the different species of *Ephedra* which yield the alkaloid Ephedrine are taken from the current number of the *Bulletin of the Imperial Institute* :—

"Although the drug Ephedra has been known to the Chinese for thousands of years its introduction into Western medicine for the treatment of asthma and hay fever is quite a recent step. The drug consists of the dried stems of certain species of *Ephedra,* small shrubby plants, the shoots of which somewhat resemble in appearance the common "horse tails," although quite distinct botanically. The value of these stems depends on their content of the alkaloid ephedrine and its isomeric form pseudoephedrine; other alkaloids are often present as well, but these apparently have no medicinal value.

Plants of the genus Ephedra occur in many of the warm dry regions of the world, but the species containing sufficient quantities of ephedrine or pseudoephedrine to be of commercial importance are few, and somewhat restricted in their geographical distribution. Although plants from Europe and Northern India have been used, by far the greatest part of the world's supply of the drug comes from China. Three species only enter into commerce to any large extent, namely, *E. sinica* Stapf, *E. equisetina* Bunge and *E. distachya L.,* all of which are sold on the Chinese markets under the name Ma-huang. The bulk of the commercial material is *E. sinica* or Tsaopen Ma-huang, which together with *E. equisetina* (Mupen Ma-huang) is collected among the T'ai-hong-shan mountains running southwards between the provinces of Chihli and Shansi. The third species, *E. distachya,* is gathered in Central China, from Shansi to Honan and Hupeh, and appears on the Yangtze markets. Information regarding the wider distribution of these plants is difficult to obtain, but it is stated that *E. sinica* occurs in Thibet, while *E. distachya* is reported from Europe. It is said that the European material of this species gives a good yield of pseudoephedrine, though plants of *E. distachya* from Asia are characterised by a relatively higher content of ephedrine.

Five species are stated to occur in India, chiefly at high altitudes in the mountains of Baluchistan and the Himalayas, while two of them have been recorded also from Western China. In investigations of Indian Ephedras which have been carried out by Krishna and Ghose (*Indian Forest Records,* 1930, Vol. 16, II.) very promising results were obtained from analyses of two closely allied species, *E. nebrodensis* Tineo and *E. Gerardiana* Wall. These proved in some cases to contain a

higher proportion of ephedrine than *E. sinica* from China; indeed, one sample of *E. nebrodensis* from Lahoul yielded 1.93 per cent. of ephedrine, which far surpasses the content of the average Chinese material. It must be noted, however, that plants of the same species from different localities were found to vary considerably in alkaloid content.

Outside China and India various species grow in Persia, Arabia, Somaliland, Europe and the Mediterranean region. So far as can be traced from the literature available at the Imperial Institute only three of these, namely, *E. vulgaris* var. *helvetica, E. distachya* and *E. alata,* have been found to contain any useful alkaloid. The first is said to form the source of the European material. Little information is available about *E. distachya* outside China, but *E. alata* is of particular interest as a possible new source of the drug, for a sample from Morocco was found to contain as much as 1 per cent. of pseudoephedrine. The plant is known to occur also in Arabia, but there appear to be no published analyses of material from that country.

Of the New World species, those growing in the United States contain no useful alkaloids, and little is known of the South American representatives.

The distribution of Ephedra is strictly limited to arid regions, and it may be generalised that the useful species require also a relatively high altitude (the Indian species occur up to 16,000 feet) and correspondingly cool climatic conditions. Whereas the alkaloid content of the Chinese species is said to be greatly affected by altitude, Krishna and Ghose (*loc. cit.*) found that the influence of rainfall plays a much more important part in the case of the Indian Ephedras, a high content of ephedrine being associated with a low rainfall, while even a single heavy rain-shower will bring about a temporary reduction in alkaloids. Thus rainfall may have a modifying effect on the general seasonal trend of the alkaloid content, which is said normally to show a steady increase through the summer months, reaching a maximum in the autumn. In spite of the effect of local climate, however, it is still generally true that the ephedrine content is highest in the autumn, and it is customary for the Chinese to harvest the stems at this season.

It has already been mentioned that practically the whole of the world's supply of Ephedra comes from China. This source has been largely cut off as a result of the war, and it is doubtful to what extent the 1937 crop has been gathered. The same is true also of Spain, which formerly produced small quantities of the drug. Towards the end of 1937 the market situation was becoming serious, as the existing stocks were extremely low, and there was no immediate prospect of further shipments. The price of ephedrine hydrochloride in bulk quantities, which at the end of July had been about 5s. per oz., had reached over 20s. per oz. by November, and quotations for the pure alkaloid had similarly risen from 6s. to 25s. per oz. The beginning of 1938 saw a slight falling off in price to 15s. per oz. for the hydrochloride and 20s. for the pure alkaloid, whilst by May the price had fallen still further to 8s.-9s. per oz. for the former, and 12s. 6d. per oz. for the latter. Fresh supplies of the crude drug have been received in small quantities, and in April, 1938, the herb was quoted at about 39s. per cwt., c.i.f., for June shipment. The improvement in the position is said to be mainly due to the introduction on the market of synthetic ephedrine hydrochloride, which it is claimed complies with the British Pharmacopœia Specification. It is understood, however, that the cost of production of the synthetic drug is much more than the normal market value of the natural product, and that its position on the market is therefore not likely to be maintained. The normal demand for the drug has increased very considerably in recent years, and further increases are likely as its use in medicine become more general.

Attention has naturally been drawn to the possibility of producing the drug in Empire countries, either by exploiting any naturally occurring species or by introducing the Chinese material into cultivation.

Various species of Ephedra do grow wild in such countries as Cyprus, Palestine and British Somaliland, but their value remains as yet unexplored. In view of the work of Krishna and Ghose referred to above, India appears promising as a possible source of the drug, and it is urged that efforts should be made to develop trade in the Indian Ephedras. So far there is not a great deal of information available regarding the

quantities in which material of high ephedrine content could be supplied from India. It is worth noting, however, that, as long ago as 1928, 34 tons of the drug were shipped to the United States, whilst it is recorded that during March, 1938, two consignments, aggregating nearly 80 tons, reached that country from India.

Among the Empire countries where the Chinese species of Ephedra might be introduced Kenya has been suggested as a possibility, and it is understood that trials have just been started there with material supplied from Kew. It will be interesting to see whether the plants will thrive and give a good yield of alkaloid under the conditions obtaining in that Colony.

Details of the plant's cultural requirements and adaptability to new soil and climatic conditions are very little known. Various species have been cultivated in England, both at Kew and elsewhere, but in all cases growth was extremely slow and the alkaloid content far too low to be of any value. Trials carried out in the United States by Christensen and Hiner, in South Dakota, proved more successful; these are fully described in the *Journal of the American Pharmaceutical Association*, Vol. 25, 1936, pp. 969-73. Seed of *E. sinica*, obtained from Peking Union Medical College, was planted in 1929, and showed excellent germination within a fortnight. Plants from the first lot of seed were reared in a greenhouse, but it was later found that the plants were hardy and would reproduce readily from seed in the open. The young plants were cultivated in nursery beds for at least two years before planting out in the field. Propagation from suckers also presented no difficulty, and it is stated that the new plants transplant well by severing them from the old root and allowing them to remain undisturbed for about three weeks before moving to their new location.

The best time for harvesting was found to be late autumn, before the first frost. The crop was simply mown in the ordinary way and allowed to cure in the field, like hay; this gave better results than oven-curing. Although the plants were large enough to cut after two years, it was found better not to harvest too soon as the alkaloid content of the young shoots is very low. Even in older plants which had been cut

the previous year the new stems of one year's growth contained little ephedrine. The stems proved winter-hardy under South Dakota conditions, although blackening somewhat, and those of two years' growth yielded up to 0.36 per cent. of ephedrine.

The climate in South Dakota, where the plants were grown is rather dry and sunny, with very cold winters. The average summer temperature is given as about 70° F., while the winter average is below 20° F., with minimum temperatures below —30° F. and sometimes more than 60 days in the year when the temperature does not rise above freezing all day. The summer growing period, free from severe frosts, is from early May to late September, on an average about 130 days. There were two regions where the Ephedra was grown—one between 2,000 and 4,000 feet altitude, with an annual rainfall of less than 15 inches, the other below 2,000 feet, having a rainfall of about 25 inches. In both cases the rain comes almost entirely in the summer.

THE LATE
Mr. C. F. M. Swynnerton, C.M.G.

On June 13th of the present year the local press reported an aeroplane accident in Tanganyika resulting in the loss of three valuable lives, including that of Mr. C. F. M. Swynnerton, C.M.G., Director of Tsetse Research, Tanganyika Territory.

It appears that the machine crashed in wild country on the 8th June and was not discovered until the 11th. Thus passed an outstanding personality and a great naturalist whose name will always be associated with Southern Rhodesia. The news came as a great shock to many in the Colony with whom he had been more or less closely associated.

Charles Francis Massy Swynnerton was the son of a senior chaplain of the Indian Army and was of Irish descent. He was born in India on the 3rd December, 1877, and was thus approaching his 61st birthday at the time of his death. He was educated at The Abbey, Tipperary, and at Lancing College.

At the end of the year 1897 he came to South Africa to meet Mr. G. A. K. Marshall, now Sir Guy Marshall, K.C.M.G., D.Sc., F.R.S., Director of the Imperial Institute of Entomology in London, who was pursuing certain entomological investigations in Natal. Marshall and Swynnerton came through to Salisbury at once and the former started a trading firm of Bates, Marshall & Co., in a building still standing in Second Street.

Swynnerton was for a short time an assistant in the store, but proved to be quite unsuited for this type of work, and in 1898 went to the Melsetter district to look after a farm belonging to the late Mr. J. W. Scott, a farm which was later included in Portuguese Territory by the Border Commission. In the meantime Marshall had purchased certain land in the district, including Gungunyana Farm, which contains a portion of the Mount Selinda forest, and in 1900 Swynnerton took over the management of this farm, eventually acquiring the greater portion of it.

The Melsetter district with the surrounding country forms a naturalist's paradise, and from the time of his arrival Swynnerton commenced to study and collect plants, insects and birds. In the course of his collecting expeditions he penetrated far into Portuguese East Africa, and on one occasion made a journey, mostly on foot, from Gungunyana to Beira.

His collections were in due course submitted to appropriate authorities in Great Britain and his plant collection was studied by Dr. A. B. Rendle, F.R.S., F.L.S., Mr. E. G. Baker, F.L.S., Mr. S. Moore, F.L.S., and Mr. A. Gepp, F.L.S. The results were published, with notes by Swynnerton, in the Linnean Society's Journal, Vol. XI., Oct., 1911, under the title of "A Contribution to our Knowledge of the Flora of Gazaland." This is a standard reference work. Swynnerton's collection was found to contain a large number of species new to science and many plants, including some of the largest forest trees, were named after their collector.

In addition to his botanical collections Swynnerton, during this period, devoted a great deal of his abounding energy to the study of "protective mimicry," "warning coloration," "palatability," etc., in insects and paid a great deal of attention to the habits of birds. The results of this work appeared in various scientifific journals, including "The Ibis," "The Journal of the Linnean Society," "The Proceedings of the Rhodesian Scientific Association," etc. He was, and remained, a firm believer in Darwinian evolution.

He also studied carefully the effect of grass fires on the local vegetation, especially in reference to tree and shrub growth, including their inroads into the high dense forests such as that of Mount Selinda. He became convinced that the existing forests are only remnants of much larger forests, which have probably been destroyed through the centuries by native cultivation and the steady intrusion of fire.

Swynnerton, on his own statement, was a naturalist first and a farmer afterwards. He was in any case an experimentalist. He did a great deal by distributing seed to encourage the experimental planting of forest trees in his district and many fine plantations of *eucalyptus* and *conifers* have resulted

from these efforts. He also experimented with various exotic crops on his farm, including coffee and ceara rubber. He is stated to have been the first to exhibit a sample of Rhodesian grown rubber at a Rhodesian agricultural show in 1909.

Rubber, however, soon dropped so much in price that the inferior Ceara product did not pay to harvest, whilst coffee proved to be so subject to the attacks of insects and of the destructive Coffee Leaf Disease, *Hemileia vastatrix*, that the industry has so far failed to develop.

Swynnerton was given a grant by the Government in 1917 or 1918 for the purpose of experimenting with sprays against the Coffee Leaf Disease and submitted a fairly optimistic report. Again in 1918 he was commissioned to investigate the tsetse fly position with reference to the many cases of fly disease which had been occurring on farms near the international border in the Chipinga sub-district since 1914. Gungunyana was included amongst these farms. Later in the year, however, he accepted a commission from the administration of the Mocambique Company's Territory to examine the tsetse fly position in the Mossurize district, and from this investigation there resulted his first publication on tsetse flies, namely, "An Examination of the Tsetse Problem in North Mossurize, Portuguese East Africa" (Bull. Ent. Res. Vol. XI. 1920-21).

Swynnerton brought a fresh mind and to a large extent a new method to the study of the tsetse fly problem. His extensive knowledge of the natural history of the country was unique and he had already interested himself greatly in ecology. In his own words he had been preparing unconsciously for fifteen years for this type of investigation. He set to work to study the distribution and density of the various species of tsetse flies in relation to the vegetation which sheltered them, and the paper cited above contained a wealth of interesting and valuable observations.

Meanwhile, the gigantic problem created by the infestation of large portions of the African dependencies by various species of tsetse flies, and the fact that the infested areas were increasing in size had become a matter of serious concern to the Colonial Office, but there appears to have been some

reluctance or difficulty in respect to financing a large-scale scheme of research. In 1919, however, the thin edge of the wedge was inserted by the appointment of Swynnerton as first Game Warden of Tanganyika Territory, his instructions being to study tsetse fly in addition to his other work. Gradually he gathered together other workers on the tsetse fly problem, and in 1929 the staff engaged on the study of tsetse fly was constituted a separate department under the title of the Department of Tsetse Research, with Swynnerton as Director.

The aim of this research was to find methods of eliminating and controlling tsetse flies, if possible, without recourse to destruction of game. Swynnerton threw himself into the task with tremendous enthusiasm, which, in spite of the formidable difficulties inherent in the undertaking and inevitable administrative friction at times, was little abated at the time of his death. The work of the Tsetse Research Department has not resulted to date in the opening up of any royal road to the elimination of tsetse fly. At the time of Swynnerton's last visit to this Colony, early in the present year, he addressed, by request, meetings of the Trypanosomiasis Committee (19th January) and of the Rhodesia Scientific Association (24th January), in which he emphasised the difficulties and complexity of the problem. Spectacular results from work of this nature are not to be anticipated. Each separate set of conditions constitutes a problem in itself and calls for close investigation. Even game reduction, which has proved so successful against *Glossina morsitans* in Southern Rhodesia, is only applicable to a few species of tsetse. The work in Tanganyika has resulted in the acretion of a great amount of valuable information concerning the habits and life economy of various species of tsetse and methods of control based on scientific knowledge have been applied locally with success. One of the most promising methods, which is now to be tried out on a large scale, is the excluding of grass fires from suitable type of country, preliminary experiments having indicated that *morsitans* at least tends to evacuate country which carries a relatively heavy crop of grass, if the latter is not burnt off seasonally.

In 1936 Swynnerton published an imposing treatise under the title of "The Tsetse Flies of East Africa, A First Study

of their Ecology, with a view to their Control," in the Transactions of the Royal Entomological Society of London (Nov., 1936). This consists of a compilation of existing knowledge on the subject.

He was awarded the C.M.G. in the Honours List at the time of His Majesty's Coronation in 1937.

Swynnerton was gifted with a most attractive personality and won the affection of all with whom he came into intimate contact. Many examples of his kindly thought for others could be given. If he loved wild things he also loved his fellow man. His bearing had a touch of old-world courtesy, which is not universal in modern society.

His love for natural history inspired his whole life. In the country around his home at Gungunyana he knew by name every plant, animal, bird and butterfly. A ramble with him through and around the Mount Selinda forest, or, in fact, through any part of the country, was pure enjoyment to anyone interested in natural history. He had a most retentive memory for the names of things, especially of trees and shrubs, in species of which Africa is so exceptionally rich. He was always finding objects of interest and recording observations bearing upon particular theories, and he infected others with his enthusiasm.

At Gungunyana Swynnerton planted many species of the forest trees outside the forest limits and established the fact that many of them were too slow in growth for practical afforestation purposes, although several, including the Red Mahogany (*Khaya nyasica*) and the Chirinda Redwood (*Pygeum africanum*) were promising, at least in the relatively humid climate of that locality. The forest was his great hobby, and he treated it like a favoured child. He preferred to call it by its Chindao name "Chirinda." Whilst he was living at Gungunyana the portion which was included in his farm was kept as a nature sanctuary. He never attempted to exploit its timber; in fact, he was perhaps too reluctant to allow even trees which were past their prime to be felled. He wanted nature unspoiled by the hand of man. He did, however, interfere with natural processes by attempting to

check the damage caused by the parasitic fig, probably *Ficus natalensis*, which strangles and destroys so many of the fine forest trees.

Swynnerton was much troubled during his last visit to find that the little Blue Duiker (*Cephalophus monticola*) was in danger of extermination in Chirinda forest and that the bird fauna had been greatly depleted by native depredations. He was anxious to secure co-operation between the three owners of land containing parts of the Chirinda forest to enforce protection of bird and animal and took some steps in this direction which were, however, not completed. This is a matter in which the State might well enforce its authority, because the Chirinda forest is unique in Southern Rhodesia, and together with its natural fauna should indubitably belong to the people.

On the occasion of all his visits to his home Swynnerton only tore himself away through his strong sense of duty. He loved Gungunyana devotedly and was never as happy elsewhere.

In 1908 Mr. Swynnerton married Nora Annie Geraldine, daughter of Mr. John Watt Smyth, of the Indian Civil Service. Mrs. Swynnerton and their three sons—Roger, Brian and Gerald—survive him. (R.W.J.)

Annual Report of the Branch of Plant Pathology

FOR THE YEAR ENDING 31ST DECEMBER, 1937.

By J. C. F. HOPKINS, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

Staff.—During the period January 1st to April 26th the Senior Plant Pathologist was absent on vacation leave.

From October 2nd to October 29th Miss A. L. Bacon, B.Sc., Professional Assistant, was absent on vacation leave and Miss M. W. Burton acted as typist.

Movements.—On his return from leave the Senior Plant Pathologist visited the University of Pretoria in connection with research into maize diseases being carried out at that institution for the Government of Southern Rhodesia.

Since the return of the Senior Plant Pathologist, 110 visits have been paid to farms, six to experimental stations and two meetings of Farmers' Associations have been attended. The farms were situated in the following districts:—Umvukwes (29), Lomagundi (20), Eastern Border (36), Salisbury (7), Mazoe (5), Marandellas and Bromley (6), Shamva (3), Rusapi (3) and Inyanga (1).

CROPS.

Tobacco.—The prolonged wet period early in the year was responsible for an abnormal development of leaf spots, which caused considerable damage to the crop. Brown spot (*Alternaria longipes*) was particularly severe in certain parts of Lomagundi, Glendale and Inyazura, doing much damage to tobacco grown on red soils. A certain amount of control was obtained by some growers who applied copper-lime dust to the plants in the field, but the position with regard to this disease is far from satisfactory.

Frog Eye (*Cercospora Nicotianae*) made headway in the first plantings, but the early cessation of the rains checked the epidemic and the disease was kept under control later in the season by the usual priming methods.

Reports from most tobacco areas indicate that mosaic disease was not very prevalent.

The rains were much delayed this season and few reports of diseases have so far been received. Seed-beds, generally, were remarkable for the almost complete absence of leaf spots. This may be attributed to the dry weather, more efficient spraying and the almost universal treatment of seed.

Maize.—Cob rots due to *Diplodia Zeae* and *Giberella Saubinetii* caused heavy damage in most districts as a result of wet conditions. *D. Zeae* was unusually prevalent, in contrast to the previous season, when it was extremely rare. *G. Saubinetii*, however, was common in both seasons.

Two further cob-rotting fungi have been identified during the year, namely, *Fusarium moniliforme*, which is generally found in association with ear worm, and *Giberella Fujikuroi* var. *subglutinans*, which has recently been shown to be a serious parasite in New Zealand.

It is gratifying to report a steadily increasing use of seed dressings by maize growers, and a more general effort to dispose of infected trash early in the year.

Wheat.—Losses due to stem rust (*Puccinia graminis*) are still causing concern amongst growers, and in the Eastern districts a number of farmers are contemplating giving up wheat growing on this account. The reasons for such heavy infection are not clear, but the production of both summer and winter wheat on the same farm, with the consequent permanent presence of uredo-spores, would appear to be one contributory factor. The fact, however, that newly introduced "rust resistant" strains remain resistant for two or three seasons and then break down suggest the presence of several physiologic strains of rust. Investigation into this phase of the trouble is proceeding.

Further cases of loose smut (*Ustilago Tritici*) have been observed, and letters giving warning of the dangers of this

disease have been sent to the growers concerned. Loose smut, which is, so far, of rare occurrence in Rhodesia, cannot be detected in wheat seed by ordinary inspection, and it is regrettable that certain growers find it necessary to import their seed from territories where the disease is widespread.

Stinking smut or bunt (*Tilletia laevis*) is of general distribution. Millers report its presence in considerable quantities every year, and that wheat rejected by the mill on account of smut infection is usually used by the grower for seed, without any preliminary disinfection. There does, however, appear to be a small increase in the number of growers who are adopting seed treatment with fungicidal dusts.

Apples.—Owing to the increase which is taking place in apple planting, it was considered necessary this season to commence a detailed study of the diseases occurring in the Colony, and to start spraying trials. From time to time in the past collections have been made of diseased material and a number of well-known fungi determined. Mildew, black rot, bitter rot, fruit cracking and several die-back diseases of world-wide distribution have been recorded, but their life histories and reactions to control measures under local conditions are unknown. Field observations this season indicate that the Rome Beauty variety is highly susceptible to mildew, especially at elevations below 4,000 feet, and that White Winter Pearmain is very susceptible to die-back. Several varieties, including Cox's Orange Pippin and Blenheim, are severely affected by bitter pit, and their successful commercial production at any but high elevations is doubtful.

Little attempt, except for one combined fungicidal and insecticidal dormant spray, is made by growers in general to control diseases, although there are a few notable exceptions, and, until more is known of the effect of spray fluids on the trees in sub-tropical summer rain areas, general recommendations cannot be made. A conservative combined insecticidal and fungicidal schedule has, however, been published, which it is hoped will be elaborated when the results of this year's spraying trials are known.

Strawberries.—The production of the excellent "Vumba" variety of strawberry in the Umtali district has been decreas-

ing for several seasons, reports indicating that uncontrollable mildew was the principal reason for crop failures.

This season it was found possible to visit the Vumba area and make investigations. Mildew was undoubtedly present, but another and more general trouble appeared to have been mistaken for mildew damage by most growers. The affection is characterised by the stunting of plants, and distortion and diminution in size of fruit, accompanied by speckling and crinkling of leaves. The symptoms are strongly suggestive of a virus disease and may, in fact, be those of strawberry "crinkle," but no time is available for detailed investigation. If the trouble is due to a virus, which would be transmitted in runners, then the failure of the "Vumba" strawberry is easily explained.

Tomatoes.—Inspections of commercially grown crops have been made wherever possible for the detection of spotted wilt. So far this disease has not been recorded in Rhodesia and its introduction would be a serious menace to the tobacco industry. Several virus diseases have been observed, however, including "bunchy top" and mosaic.

An undetermined virus disease, which may be American "streak," has been sent to England for report. It is transmissible to tobacco, causing severe necrosis of leaves and stems and eventual death of the plant.

ROUTINE.

General.—Whilst the Senior Plant Pathologist was absent on leave, a complete revision of the pathogen and host card indexes was made by the Professional Assistant. All records were checked with the herbarium and accession book, and the whole arranged under botanical instead of common-name headings. The mycological records have now assumed such large proportions that the use of common names for hosts was leading to confusion. Also, the herbarium has been re-jacketed under botanical generic headings.

An economic card index giving summarised details of diseases and their control has been commenced and is used for standard recommendations to correspondents.

During the year the mycological collection of the late Mr. Fred Eyles was kindly presented to this branch by the trustees of the Queen Victoria Memorial Museum. The specimens have all been examined, checked and added to the herbarium.

The records from the Eyles collection, together with 190 further records, kindly supplied by the Principal Plant Pathologist of the Union Department of Agriculture, have been entered in the apporpriate indexes, and two lists, one a revised list of plant diseases and the other the first list of Rhodesian fungi, have been prepared for publication.

Legislation.—Matters under consideration during the year included prohibition of importation of vegetative parts of plants known to be hosts of the spotted wilt virus, of bulbs and rooted plants from *Citrus* canker areas, and of all species of *Opuntia*. A test of the practicability of certification of local potato "seed" was also arranged at the request of the Potato Pool Board.

Publications.—The following articles were published during the year:—

In the *Rhodesia Agricultural Journal*—

"A Programme for the Control of Diseases of Apple Trees in Southern Rhodesia." August issue.

"Seasonal Notes on Tobacco Diseases 10.
Precautionary Measures in Seed-beds." October issue.

In the *Bulawayo Chronicle*, September 1st—

"Seasonal Notes on Diseases of Garden Plants."

Botany.—The Professional Assistant has devoted a considerable amount of time to determining, mounting and recording botanical specimens collected by officers of the Department or members of the public.

Plant Protection Propaganda.—An entirely new exhibit was this year put on the Salisbury Agricultural Show in an endeavour to interest the public in the diseases of miscellaneous crops and garden plants. As a result of numerous enquiries which followed, free samples of spray materials, such as colloidal sulphur and special types of spreader which it is desired to popularise, were sent to interested growers.

LABORATORY.—One hundred and eighty-six lots of material have been received for diagnosis and report since the beginning of May, from which thirty-seven diseases have been newly recorded in the Colony. New records of interest are:—Virus disease of tomato, probably "American streak"; mosaic and rust (*Keuhneola Fici*) of fig, mildew (*Erysiphe graminis*) of wheat, mildew (*Erysiphe Polygoni*) of lupins, die-back (*Fusarium culmorum*) of carnation, black rot (*Physalospora obtusa*) of pear, die-back (*Haplosporella Mali=P. obtusa*) and sooty blotch (*Gloeodes pomigena*) of apple, anthracnose (*Gloeosporium ?venetum*) of wild bramble, black rot (*Phoma* sp. nov.) of paw-paw, boron deficiency of citrus, "yellows" (virus) of celery, rust (*Phragmidium disciflorum*) of rose, cob rots (*Fusarium moniliforme* and *Giberella Fujikuroi* var. *subglutinans*) of maize, damping-off (*Pythium ultimum*) of tobacco, leaf spot (*Colletotrichum Camelliae*) of camellia, mildew (*Phyllactinia corylea*) of phlox, root rot (*Sclerotium Rolfsii*) of pansy, halo blight (*Bacterium medicaginis* var. *phaseolicola*) of French beans, leaf spot (*Catacauma Pterocarpi*) of *Pterocarpus angolensis* and "hollow heart" of potato. Perithecia of sooty mould (*Capnodium salicinum*) of *Citrus* were found for the first time.

The material received this year has covered a very wide range of host plants, which accounts for the large number of newly recorded diseases. In the majority of cases it was possible to recommend control measures confidently, but in some instances investigation of the particular disease under local conditions will be necessary before definite advice can be given.

A large amount of diseased apple material was received, which necessitated much cultural work besides microscopic examination. These duties were undertaken by the Professional Assistant, who has obtained six fungi in pure culture. These include *Phomopsis Mali, Valsa leucostoma, Coniothecium chomatosporum,* and *Haplosporella Mali.*

The Professional Assistant has also collected and examined cob rots of maize and has isolated in pure culture *Diplodia Zeae, Giberella Saubinetii, Fusarium moniliforme* and *Giberella Fujikuroi* var. *subglutinans*, the last two not having been found in the Colony before. The cultures were

all dispatched to Pretoria University to be used in the "Diplodia" investigations being carried out there.

The use of ultra-violet light for the detection of "Diplodia" contamination of maize meal was tested, but the method was found to be unsatisfactory.

Fructifications of Agaricaceae collected by the Forestry Branch near pine plantations were sent in for report as to their being connected with mycorrhiza. The material has been preserved and sent to Kew for specialist determination.

Cultures of legume nodule bacteria have been bulked up and maintained for the Agriculturist and determinations made of cheese moulds for the Chief Dairy Officer.

Facilities were afforded to Mr. G. R. Bates for the study of fungi isolated from citrus, and acknowledgement is made of reciprocal courtesy from the British South Africa Company.

RESEARCH.

Wheat.—Collections of stem rust (49) from different parts of the Colony have been made and sent to Professor Verwoerd, at Stellenbosch, who has kindly volunteered to determine the physiologic strains present. Grateful acknowledgement is made of this offer.

Investigation of the so-called "blue ear" disease was commenced, but has had to be shelved owing to pressure of work in other directions. Preliminary examination revealed the presence of a species of *Fusarium* in the crown roots of affected plants, but an undetermined fungus is present on the glumes of diseased ears. It was shown that the disease is not a manifestation of rust infection, as suggested by some growers.

Apples.—The majority of time available for research work has been devoted to a survey of apple diseases. As reported above, the Professional Assistant has isolated six fungi, the reactions of which to various varieties of apple trees and fruits

she is studying by means of inoculation trials. This information is essential for the formulation of suitable control measures.

Field and laboratory examination of mildew has shown its life history to be similar to that reported from elsewhere. Spraying trials have been kindly undertaken by Mr. H. Storey, of Frogmore Estates, and Captain R. von Broembsen, of Rusapi, and are progressing satisfactorily.

Maize.—A series of projects to determine the behaviour of cob rotting fungi in compost and kraal manure have been drawn up in conjunction with Professor Hector, of Pretoria Universtiy, and reports indicate that good headway is being made.

Peas.—Early in the year work was commenced on breeding a mildew resistant, marrowfat pea, which could be grown during the summer months.

Nine commercial varieties were planted and cooking tests made on them all by the Professional Aassistant. Nineteen selections were made for palatability as well as mildew resistance, and a further generation raised. Most of the progeny were discarded owing to unsuitability of type or flavour, and single plant and mass selection made of the remainder.

Beans.—Seven varieties of French beans, reputedly resistant to "halo" blight, and an anthracnose resistant strain have been obtained from the Union and Britain.

Acknowledgement is made to Mr. L. Ogilvie, of Long Ashton Research Station, Bristol, and to Dr. V. Wager, of the Union Department of Agriculture, for their kind assistance.

The beans have been planted for test under local conditions, but are not sufficiently advanced to be reported upon.

Paw-Paw.—A black rot of paw-paw fruit has been found to be due to a new species of *Phoma*. Inoculation tests have

proved the pathenogenicity of the fungus and a description of the disease and organism has been prepared for early publication. Control was obtained by Bordeaux Mixture spray.

Tomato.—A virus disease similar to the American "streak" has been investigated. When transmitted to tobacco it caused severe vein and spot necrosis followed by wilting and death of the plants. Specimens have been sent to England for specialist report.

Delphinium.—A disease, suspected to be due to a virus, which causes mottling of leaves and fasciation and distortion of the flowering spike has been investigated. Attempts to transmit it to tobacco and tomato have failed, so that the original fear that the spotted wilt virus might have been concerned does not appear to be justified.

The Detection and Prevention of the Diseases of Stock in Rhodesia.

By L. E. W. BEVAN, M.R.C.V.S., late Director of Veterinary Research.

[NOTE.—The following notes on the detection and prevention of the diseases of stock in this country were contributed by Mr. Bevan and appeared in this Journal in 1911. They appear to be as useful to-day as they were then, and are reproduced at the request of some of our readers.—Editor.]

In Rhodesia where diseases so often run a rapid course, and where epidemics, insidious at first, quickly assume alarming proportions, it is of the greatest importance that every stock owner should learn to detect, and, as far as possible, to arrest disease at its onset.

To do this he must recognise that the border-line between health and disease is often so ill-defined that it is only by becoming intimately acquainted with the habits and appearance of his stock at all times that he can hope to detect any transition from normal to abnormal. He must therefore train his powers of observation by a regular and systematic examination of his animals, commencing with the herd or flock as a whole and narrowing down to the individual.

Such an *examination of a number* of animals must necessarily be tedious and incomplete at first, but with practice and system it will become easy, rapid and exact, and, in time, will be performed almost sub-consciously. The careful stock owner will cast his eye over his animals early in the morning before they leave the stable or kraal, for it often happens that sick animals look their worst after the cold or discomforts of the

night when they have been for some time without food or water. When they are turned out to graze and as they return at night, he will closely watch them, paying particular attention to those that come last, for it is generally among the stragglers that those which are sick are to be found

When at pasture his attention will be quickly attracted by any one of the following indications. His eye will be drawn to the animal which remains apart from the rest, is continually lying down when the others are standing or *vice versa,* assumes an unusual attitude, lags behind when the troop is moving, walks lame or with an unsteady gait, does not feed when the others are grazing, has a morbid or depraved appetite or unusual thirst, appears dull, nervous, vicious or restless, has a dry or "staring" coat, or appears thinner, weaker or less thrifty than the rest of the herd.

Among draught animals he will note any unusual sluggishness, dullness, weakness, excessive sweating, difficulty in breathing or irregularity in the manner in which the work is performed.

Any of the above indications are the "danger signals" of disease and should be followed by an examination of the suspected animals at *close quarters.* The observer should not approach so hastily as to alarm or disturb the animals, but should quietly and unostentatiously make his way up to it, carefully watching for any signs which may be afforded by it in its natural condition. Much information may also be obtained from the stable door. At this time some special attention should be given to the behaviour, attitude and appearance, the carriage of the head and ears, facial expression, general condition, state of the coat, character of breathing, whether ruminating—in the case of cattle and sheep—manner of voiding excreta, character of fæces and urine, and the presence of unusual discharges from mouth, nose or eyes.

Next the animal should be approached and secured as quietly as possible and a careful and *minute examination* should be made in a thorough and systematic manner.

While it is generally possible to manipulate horses, mules and cattle are more difficult to handle and may need some

method of restraint. Mules are more often easy to manage in bridles with blinkers than with simple head-stalls. For such purposes a *crush-pen* is in this country almost a necessity on every farm. This consists of an enclosure made of stout smooth wood, having two sides about eight feet long, four and a half feet high, about two and a half feet apart, running parallel with each other. The sides may be closer together at the ground and, indeed, need be only two feet apart at the top, but the above measurement may be found convenient as long horned cattle can enter without discomfort. At each end slip-rails are placed at right angles to the sides and at a distance of two, three and four feet from the ground. The box-like enclosure thus formed is approached by two converging sides forming a V shape "race." This structure may with advantage be situated at the exit of the kraal and the cattle may pass through it regularly, in this way becoming accustomed to it. When necessary, the front cross-bars having been inserted, the animal is run in as usual and the hind bars quickly pushed across behind it so that it is held prisoner in the "pen." If the crush is constructed wider than 2 ft. 6 ins. there is a danger of the animal trying to turn and thus injuring itself.

The uses of a crush-pen are unlimited; animals secured in it can be handled quietly and quickly, they can be sprayed or hand dressed, medicines can be given to them, operations may be performed upon them, they may be minutely examined and their temperatures can be taken with impunity by the operator. In dealing with epidemics, where a number of animals have to be handled, a crush-pen is almost an essential, and it behoves every farmer to erect one, not only to enable him to handle his stock at all times but to facilitate the immediate and minute examination of his animals when contagious disease has broken out amongst them. The failure to take this simple precaution has frequently resulted in considerable loss of valuable time in which preventive measures might have been put into operation.

It is to be remembered that in order to arrive at a correct idea as to the state of an animal under examination, one must try to avoid giving rise to an unnatural condition by chasing and rough-handling, thereby causing excitement or nervous-

ness. While gaining the confidence of the patient by handling, patting and stroking, note should be taken of the *external body temperature,* as indicated by the relative heat of the general surface and extremities (ears, horns, nose, legs and feet). In a state of health these present a uniform sense of warmth, but in disease are liable to considerable variations in temperature. In this way information may be gained as to the state of the heart and its power to drive blood through the system. The extremities being the first to suffer from any loss of power (*vis a tergo*) are proportionately colder than the parts nearer the heart. In some cases it may be noted that the extremities are "deathly cold" while the body is bathed in a cold sweat, a condition which often indicates heart failure and oncoming death. In fever and in some nervous conditions the surface temperature may be elevated, while in anæmia, collapse, and some wasting diseases, it may be reduced.

The usual indications of inflammation are heat, pain, redness and swelling, but in veterinary patients it frequently happens that the increased heat of the affected area is the only appreciable symptom. These localised areas of increased temperature are of great value in diagnosis. Thus lameness due to an injury of the foot, sprain of a tendon or joint may sometimes be detected by the unusual heat in these parts; such estimation being based upon a comparative examination of suspected parts with others considered to be normal. Differences in external body temperature are sometimes so slight as to be almost inappreciable when using the palm of the hand; it is often advisable to apply the back of the hand where the skin is less coarse. And it must be remembered that warmth is often imparted by excessive handling. Some specific diseases are associated with increased heat of the parts involved, as for example, fever of the feet (laminitis), rheumatism, etc.

At this stage it may be well to remark the *condition of the skin and* the coat of the animal. In the healthy subject the hair should be soft and oily and should lie smoothly, but in animals suffering from fever or loss of condition arising from many causes, such as worm infestation or parasitic invasion of the blood (plasmosis, fly-disease) the hair becomes dry and brittle and the coat appears dull, staring and dusty. Some

of the tick-borne diseases of animals in this country are accompanied by an unhealthy condition of the skin, which, again, appears to be particularly favourable to ticks—a most unfortunate association between cause and effect. In a healthy animal the skin is easily pinched into a fold and moves freely upon the ribs, while in sickness the animal may be "hide-bound." One should examine the skin for such conditions as mange, scab, ringworm and tick infestation.

Examination of Eyes.—A clear bright eye is indicative of health and must be distinguished from the glassy lustrous eye associated with fever and pain. A dull appearance is sometimes given to an animal by the swelling of the tissues round the eye, as for example, in African Coast Fever and Redwater in cattle, and Biliary Fever of the horse. In the "dik-kop" form of horse-sickness a swelling may replace the hollow situated between the eye and the base of the ear.

Discharge from the eyes is present in some infective diseases and is, as a rule, milateral (*i.e.*, *f*rom both eyes). A discharge from one eye is generally caused by some local irritation.

Opacity of the cornea or transparent horny membrane comprising the forepart of the eye, may be caused by injury, but is often met with in specific diseases, *e.g.*, tsetse-fly disease.

Some forms of opthalmia are very infectious, and not only should the first cases be detected early and treated, but means should be taken to prevent the spread of the disease to in-contact animals. This is specially the case in the eye disease so common among calves. Some forms of opthalmia, if not actually transmitted by flies are aggravated by them, and in equines it is advisable to protect the eyes with fly-fringes at those times of the year when insects are most aggressive. Further, the tears and inflammatory discharges should not be allowed to accumulate around the eye, since they appear to attract flies, which may eventually give rise to bad sores at the corner of the eye and along the tear tracts.

The conjunctiva should be examined. This is the mucous membrane lining the inner aspect of the eyelids and reflected on the front of the eye-ball. It also covers the cartilaginous

body at the inner angle of the eye, known as the "membrana nictitans" or haw. In the horse an examination may be made by everting the eyelids with the thumb and index finger. By using the index finger for the upper lid and gently pressing the everted lid inward and forward into the socket of the eye, the haw is pushed over the ball of the eye and can be examined. In the ox a good view of the conjunctiva may be obtained by simply taking hold of a horn and the nose and drawing the head to one side. *The Colour* of the conjunctiva should be compared with that of other mucous membranes, and is of immense diagnostic value, inasmuch as it serves to determine the quantity and quality of the circulating blood. In this country the importance of the indications to be thus obtained cannot be over-estimated. The normal colour of the conjunctiva of a healthy animal must be learnt by practice in order that deviations from normal can be detected and interpreted. It may be described as a pale rose-colour in equines, while in bovines it is rather paler than in other animals. A careful examination of both eyes should be made to guard against mistakes, and the colour should be compared with that of the lining membrane of the lips, gums and tongue. The colour of the conjunctiva is influenced by:—

1. The quantity of the blood in the system.
2. The quality of the blood in the system.
3. The distribution of the blood, depending upon the state of the heart and vessels.

A *pale* or *anæmic* colour indicates (*a*) that the quantity of the blood in the animal is less than normal, or (*b*) that the blood has not its normal quota of blood cells, or (*c*) that the blood cells are deficient in colouring matter.

The membranes may become suddenly pale, as from great loss of blood caused by external or internal hæmorrhage.

The condition known as *anæmia* is frequently met with in animals in this country, and is brought about by many circumstances, such as deficiency of food, or the action of minute parasites in the blood stream, causing a diminution in the number of or actual mechanical destruction of the red-blood cells (as in fly-disease, plasmosis). It may also be due to the presence of larger parasites, such as intestinal worms, which live at the expense of their host.

A condition of deficiency or poverty of the blood frequently results in the escape of the fluid elements into the various body cavities, such as the heart-sac, the chest and abdominal cavities (dropsy, "pot-belly"). The transuded fluid may also gravitate into the dependent parts, collecting under the skin or causing swelling of the limbs. The "tick fevers" of calves are frequently characterised by a pendulous condition of the skin between the jaws, which is often an indication of worm infestation in sheep.

The condition known as *jaundice* is characterised by yellow discolouration of the membranes and tissues, the varying shades of yellow being very well marked in the conjunctiva. This discolouration is due to an abnormal amount of bile-colouring matter circulating in the blood, which may be derived from (*a*) dissolution of the red blood cells, as for example, in diseases caused by blood parasites, *e.g.*, redwater of cattle, biliary fever of the horse, etc.; (*b*) reabsorption following the accumulation of bile in the liver as the result of some obstruction to its escape into the bowel. Various phenomena accompany jaundice, such as indigestion, constipation, clay-coloured fæces, general dullness and unthriftiness. When jaundice is associated with anæmia the membranes vary in colour from lemon yellow to ochre; when the membranes are, at the same time, congested or inflamed the yellow is masked and all shades of colour from salmon to brick-red are met with.

An increased *redness* of the membranes may be a temporary condition due to (1) over-excitement, or (2) to diminished power of the circulatory system, or (3) may indicate a depraved state of the blood which may be deficient in oxygen or may contain toxic materials. In those diseases which are caused by the invasion of the blood by micro-organisms this is frequently met with in the last stages, *e.g.*, horse-sickness, African Coast fever. A congested condition of the conjunctiva may also be present when mucous membranes in other parts of the body are inflamed, as for example, in inflammation of the bowels.

(*To be continued.*)

Report of the Chief Animal Husbandry Officer
FOR THE YEAR ENDING 31ST DECEMBER, 1937.

By A. E. ROMYN, Chief Animal Husbandry Officer.

Cattle Industry.—The progress made in the cattle industry last year was maintained during the 12 months under review. The World Trade in beef improved considerably and this Colony benefited from the better prices ruling overseas. According to present indications satisfactory prices for cattle should be maintained in 1938. The effects of the 1933-34 drought, which are now making their presence felt in the shortage of mature cattle for marketing, and the increased demand for slaughter cattle in the North will, however, probably result in a decreased number of cattle for export in 1938.

The general condition of the cattle in the Colony has been very good during the year. Matabeleland has had an exceptionally good season. There was a general set-back in the latter part of the year owing to the lateness of the rains, but the rains in December have already led to much improvement in the condition of the stock. A larger number of chillers, probably between eight and ten thousand head, a considerable proportion of which graded "Imperial," were exported "off the grass" with practically no supplementary feed. This is the largest total of grass-fed chillers since 1934.

Despite the very favourable season up to October, the wintering of cattle proved an acute problem in Western Matabeleland and in parts of the Midlands owing to the lateness of the rains. Heavy losses occurred on some properties which were over-stocked or where insufficient provision had been made for winter feeding. It is commonly said that "cattle do not do as well as they used to," or that "the winters are becoming longer." These statements are true in part, and it must be realised that the cumulative effects of over-stocking,

the drying out of the vleis, the greater inroads of internal parasites—the one leading to the other—must be met by better systems of veld management and a greater provision of winter feed if the cattle industry is to progress further.

Chilled Beef.—The prices for chilled beef continued to rise during 1937. The average gross price realised per consignment during the last three months in this year was approximately 4.4d. per pound as compared with $3\frac{3}{4}$d. per pound for the corresponding period in 1936. The rise in the value of hides and by-products has also been an important factor in strengthening the market. The quality of chilled beef exported during 1937 was generally satisfactory. The average age of the cattle exported was lower than in the previous year, though a good proportion of mature bullocks still come forward.

During two periods of the year, however, the average quality of the consignments exported was not good. These periods occurred in June and July, when the best grass-fed cattle had been exported and stall-fed cattle were not yet available in quantity, and during November and December when the supply of "stall-feds" had been exhausted. The latter gap was partly accounted for by the late season, but in the future more definite arrangements should be made to maintain a uniform supply of cattle during these periods.

Satisfactory reports on the beef exported have been received. The demand for Rhodesian beef is improving and it seems now to have found a definite place in the market. Considerable further improvement is called for, however, in regard to age in the cattle exported from this Colony.

The condition of the beef on arrival was not always satisfactory and improvement must be made in this connection also. The reports of Colonel T. D. Young, the Veterinary Advisor to this Department in the United Kingdom, have been of much value in drawing attention to this aspect of the work.

The Senior Animal Husbandry Officer in Charge of the Rhodes Matopo Estate made an extensive tour of investigation throughout North and South America and the United Kingdom during the year. His report on conditions in South America, together with the investigations which he made at Smithfield in co-operation with the London Agents and staff,

have been of great value in defining definitely the causes of the unsatisfactory condition of some of the Rhodesian chilled beef on arrival in the United Kingdom.

Chilled beef was graded during the year into "Imperial" and "Standard" grades. The average difference in the gross price realised between these two grades was less than $\frac{1}{4}$d. per lb. This margin is not sufficient to cover the difference in the cost of production between these two grades of beef. It is considered that one of the chief reasons for such a small difference in price is that it has not been possible, on account of the limited number of young bullocks available, to exclude the mature, heavy, well finished bullock from the "Imperial" grade. The inclusion of these older bullocks tends to bring down the general level of the prices for the whole grade. More young bullocks are now coming forward, and it should be possible in 1938 to grade more strictly for age in the Imperial grade. It is then anticipated that the producer of the young bullock which grades "Imperial" will secure a relatively better return for his feed and progressiveneess than he does at present.

The experimental work at the Rhodes Matopo Estate has demonstrated that a saving of 12-18 months in the age at marketing can be effected by providing a limited amount of a protein supplement for the young stock during the winter months. Where this cannot be done, this Division has advocated strongly the selling of the weaners before they lose their condition, to feeders who are in a position to keep the cattle growing.

The idea of selling weaners is a new one to most producers in the Colony, but in it probably lies one of the main opportunities for improvement for the industry.

This Division has been active in propaganda work to encourage the sale of young stock. Demonstrations and experiments have been arranged to determine the commercial value of these cattle, and it is hoped to organise the sale of a number of suitable Matabeleland weaners to Mashonaland feeders early in 1938.

The supply of the heavier type of store bullock, to which the local trade is accustomed, is altogether inadequate and

likely to become more so. Once bullocks reach this stage, most ranchers find it more profitable to fatten them themselves rather than to sell them at the prices which Mashonaland feeders are prepared to pay at present. This shortage of heavy feeders will lead the maize grower to show a greater interest in the purchase of weaners and young stores to the eventual advantage of the whole industry. In this connection it is encouraging to note that some of the larger maize growers are now purchasing sand veld farms on which to grow out young stock as well as to breed their own young steers.

Prices Paid for Chillers.—The guaranteed scale of prices for chillers for export in 1937 was as follows:—

	"Imperial" per 100 lbs. dressed weight.	"Standard" per 100 lbs. dressed weight.
April, 1937	25/6	22/-
May, 1937	25/6	22/-
June, 1937	26/-	22/6
July, 1937...	26/6	23/-
August, 1937...	27/-	23/6
September, 1937	27/6	24/-
October, 1937...	28/-	24/6
November, 1937	28/6	25/-
December, 1937	29/-	25/6
January, 1938	28/-	24/6
February, 1938	26/6	23/-
March, 1938	25/6	22/-
April, 1938	25/6	22/-

In the latter half of the year an alteration was made in the terms of the annual purchase agreement for the purchase of cattle with the Rhodesian Export & Cold Storage Company and consequently the Company paid prices in excess of those guaranteed.

Frozen Beef.—11,421 head of cattle were exported as frozen beef during 1937. The bulk of these cattle were utilised for the Italian contract, but small quantities of frozen beef were also marketed at a fairly satisfactory price in the United Kingdom.

Boneless Beef.—12,700 head of cattle were slaughtered for boneless beef in the course of the year. The export of these cattle had a stabilising effect on the local market for mediums and compounds.

Owing to the rise in price for hides and by-products the Company paid very reasonable prices for this class of cattle with the assistance of an export bounty of only $\frac{1}{4}$d. per lb. dressed weight.

Extract of Beef.—Messrs. Liebig's Company at West Nicholson slaughtered 26,599 head of cattle for the manufacture of extract of beef and other beef products in 1937. The operations of this Company are unobtrusive and continue to be of considerable value to the country in affording an outlet for the cattle in the quarantine areas and also for inferior stock.

Bounties on Export.—The system of bounties on beef exported was continued during the year. The respective rates of bounties have been published in Government Notices Nos. 162, 387, 402, 627 of 1937.

Expropriation of the Rhodesian Export and Cold Storage Company.—Towards the end of the year the decision was made to expropriate the Rhodesian Export and Cold Storage Company and to place the management under the control of a Cold Storage Commission.

Johannesburg Market.—4,305 head of cattle were exported to Johannesburg during the year. The trade was interrupted from the 5th January to the 27th April by veterinary restrictions. Towards the end of the year, however, the prices on the Johannesburg market proved very attractive to producers in this Colony. As a result, the Rhodesian Export and Cold Storage Company found it very difficult to obtain chillers in Mashonaland for export overseas at the prices guaranteed in the Agreement. If the Company had not made arrangements to feed large numbers of bullocks, under its own supervision, it would have found it very difficult to obtain sufficient bullocks to maintain a reasonable volume of chilled beef for export overseas in competition with the Johannesburg market. The situation is unsatisfactory and the present export tax is

not adequate to prevent the sale of chiller bullocks in the Union. The Johannesburg market has tended to place a premium on the heavy, fat bullocks to the disadvantage of the younger bullock on which the vital export depends, and this competition from the South should be controlled in the interests of the industry.

The same problem is likely to confront the new Cold Storage Commission. It has been suggested that the export of cattle from this Colony to other territories in South Africa should be controlled by one body. It has been proposed that such an organisation would pay reasonable prices for cattle so exported but would not take "chillers" if the supply of them for export was insufficient. The vital export trade in chilled beef would consequently receive first preference and any profits made by the organisation on South African markets would be used to stimulate the chilled beef trade.

Local Market.—The local market was maintained at a very satisfactory level throughout the year. Towards the end of November prime beef fetched as much as 50/- per 100 lbs. dressed weight on the local market, a level which has not been touched for many years.

Purebred Breeding Cattle.—The breeders of pedigree cattle had a satisfactory year on the whole. More confidence in the future of the industry is now being shown. The sale of bulls in 1937 was good, and in several cases breeders have already sold part of the crop of bull calves, which normally would not have come on to the market until June or September, 1938. A further improvement in the demand for bulls is likely to reveal a serious local shortage. It has been estimated that it would require an annual supply of 3,000 bulls for the next five years to effect a radical improvement in the quality of the bulls in use.

As less than 500 pure bred bulls of good type are produced annually in the Colony it will readily be appreciated that there actually is a very serious potential shortage of bulls, though the demand at present does not far exceed the number produced.

Statements are often made that there has been a general deterioration in the quality of the stock in the Colony during

the last 10 years. While this generalisation is undeniably true as far as the beef breeds are concerned, the deterioration has been arrested to a considerable extent during the last two years. The improvement in the cattle market has encouraged cattle producers to take more interest in their cattle, and one direction in which this interest has had a marked effect is in the feeding of young stock, which has resulted in considerable improvement in the quality of many herds. It is well that such improvement in the feeding and management conditions should procede the use of finer bred bulls in these herds.

Livestock Improvement Scheme.—The following table shows the number of applications for grants received and approved under the Livestock Improvement Scheme for the three years 1935, 1936 and 1937, over which period a total sum of £8,500 has been made available. During the current year, and in addition to the number of applications shown, numerous enquiries were received which, however, were not followed up by definite applications owing to the funds being fully committed to earlier applicants.

Year.	BULLS. No. of applications.		RAMS. No. of applications.		BOARS. No. of applications.	
	Received.	Approved.	Received.	Approved.	Received.	Approved.
1935	241	175	90	71	18	5
1936	218	109	31	12	25	9
1937	200	134	63	57	13	8
Totals	659	418	184	140	56	22

Of the 200 applications for grants in respect of cattle received during 1937, 134 have been approved, 26 refused and 9 withdrawn by the applicants, whilst 31 are being held over for further consideration in the event of approved applicants to whom the available funds are committed not utilising their grants within the time limit in their respective cases.

Up to the time of writing this report grants have been paid to 96 of the 134 approved applicants to assist them in terms of the scheme towards the purchase of 114 bulls and 1 heifer. These animals were of the following breeds:—

Aberdeen Angus	31	
Hereford...	22	
Friesland...	20	
Africander	12	
Red Poll	9	bulls and 1 heifer.
Shorthorn	8	
Sussex	7	
Guernsey	3	
North Devon	2	

During the last three years certain undesirable features in connection with the administration of this Scheme have developed which, to a certain extent, tend to nullify some of its great benefits in other directions.

Many farmers seem to have grown to regard these grants as a right and, if they are not made to them, do not buy good bulls no matter how urgent the need for them. When funds for the year are exhausted, they delay the purchase of a bull or bulls to the next financial year when funds may be available.

The Government grant has also had the tendency to stabilise the price of medium bulls at around £30-£35 and, in certain instances, there are grounds for the suspicion that there has been a certain amount of agreement between the purchaser and seller to get full advantage of the maximum amount of Government assistance. This agreement cannot be wholly overcome by a valuation of the bull by the inspector.

Further, the sale of bulls towards the end of the financial year is undoubtedly hindered when the funds available for the making of grants under this scheme have all been allocated.

For these reasons it seems that the time has arrived to alter the basis of financing the scheme and certain changes are under consideration.

Grading of Beef for Local Consumption.—A grading system for beef for local consumption was introduced in Bulawayo in July of this year.

The grading at present is on an optional basis. Any butcher who desires it can have the cattle slaughtered by him graded and the beef marked with a rubber stamp with the

words "Government Graded Choice" to indicate that the beef has reached a certain definite standard for age and quality. The consumer, by asking forthis graded beef, can be assured of getting beef of good quality.

The scheme did not meet with a great deal of support from the public to start with, but towards the end of the year considerably more interest was shown in this graded beef. The scheme, unfortunately, received a set-back at this point owing to the shortage of suitable cattle for slaughter in November and December. It is essential to the success of a scheme of this sort to have a reasonably uniform supply of the grade of beef required.

It is still too early to report on the success of this "Choice Beef," but present indications are promising and it is intended to continue with the service.

There have been a number of requests from the public in Salisbury to have this grading service extended to that City. It is likely that there will be more support for the grading system in Salisbury than in Bulawayo, but at present it is not possible, however, to extend the grading service on account of lack of staff.

The number of carcases graded in Bulawayo is as follows :

July...	64 carcases.
August	47 ,,
September...	51 ,,
October	61 ,,
November	87 ,,
December	71 ,,
Total	381 carcases.

Pig Industry.—The pig industry in the Colony has shown the usual fluctuations during the last twelve months. The year started fairly well, but by March a surplus of pigs developed and the price of first grade baconers dropped to 3½d. per lb. liveweight, and in most cases they were only saleable on a quota basis, even at this figure. A number of pig producers cut down their feeding and breeding operations,

and towards the end of the year a serious shortage of pigs in the Colony developed. The prices for first grade baconers in November and December reached 4½d. per lb. liveweight, and even at this figure the factories were unable to supply the full requirements of the Christmas trade, and many light weight and unsuitable pigs had to be killed and cured into bacon.

During the year the Pig Industry Act, 1937, was passed by Parliament. This Act provides means to organise the pig industry, to foster export and so to prevent as far as possible the fluctuations which have occurred in the industry in the past.

The necessity of an export trade in order to develop the industry has always been realised, and small shipments of frozen porkers and baconers have been made during the last three years by this Department to gain experience in the trade and test out market conditions in the United Kingdom.

Three small consignments of frozen baconers and green bacon were shipped to the United Kingdom by the Rhodesian Export and Cold Storage Company. The baconers and bacon shipped by this Company were representative of the ordinary run of pigs produced in the Colony at present and proved over-fat for the English trade.

A consignment of frozen porkers were shipped by this Department to Smithfield during the year and realised the satisfactory price of 6.6d. per pound. A full report on five shipments of frozen porkers which have been undertaken by this Department to date has been published in the December, 1937, issue of the *Rhodesia Agricultural Journal.*

There are no great technical difficulties to be overcome in the export of pigs and, at prices at present ruling overseas, it should not be difficult to develop a useful trade from the Colony. The absence of slaughtering facilities for export at Salisbury is a handicap at present as far as Mashonaland is concerned, but it is probable that such facilities will be provided when the trade justifies it. Costs of production on the farm will have to be lowered. The average production of pigs per sow, however, is only a fraction of what it should be and the inroads of internal parasites is a serious factor in many herds. The control of these two factors would aid very materially in lowering the costs of production.

Local manufacturers have shown commendable initiative this year in developing an export trade with adjacent territories and an outlet for tinned hams has been found which should be of great benefit to pig producers in the Colony as, in the past, it has been difficult to dispose of the full quantity of hams produced. As a result producers have tended to concentrate on the breeding of a long pig with rather poor ham development. This type of pig is not necessarily an economic feeder and is not the best for export.

The increased production of pure Large White baconers is an interesting development in the field of pig breeding during the last year. On certain farms these pigs have done very well and are considered by the producers concerned to be superior to the Large White x Large Black cross usually recommended by this Department. It is too early to state definitely whether the pure Large White will be a satisfactory bacon pig in the Colony generally. The development is, however, a logical one, and it is instructive to note how the popular crosses have changed in this Colony in recent years. In the early days when pig management, generally speaking, was poor, the Berkshire x Large Black cross was considered the most satisfactory cross. With improved conditions this cross turned out to be too fat for bacon production and a change was made to the Large White x Large Black cross. With a further improvement in feeding conditions this cross too has often proved overfat where proper selection in breeding stock is not practiced and consequently some feeders are now turning to the pure Large White as the leanest of all the types.

Experimental Work.—(*a*) *Rhodes Matopo Estate.*—A number of experiments were completed on the Rhodes Matopo Estate in connection with the feeding of cattle and pigs. Full reports on these experiments have been published in the *Rhodesia Agricultural Journal* and in most cases reprinted as bulletins. The following is a list of the bulletins which have been printed during the past twelve months:—

1. Cowpea Molasses Silage for Fattening Steers. Bulletin 1023—April, 1937.
2. The Comparative Feeding Value of Maize Meal and Nyouti Meal for Fattening Steers. Bulletin 1024—April, 1937.

3. The Feeding of Different Winter Supplements to Young Steers and the effect of these Supplements on the subsequent development and costs of production of the Steers. Bulletin 1030—June, 1937.
4. Nyouti or Munga as a Feed for Bacon Pigs. Bulletin 1034—June, 1937.
5. Preliminary Report on Feeding Winter Supplements to Young Steers and the effect of these Supplements on the subsequent development and costs of production of the Steers. Bulletin 1036—July, 1937.
6. The Export of Frozen Porkers. Bulletin 1049—December, 1937.

(*b*) *Estes Park.*—Two co-operative pig feeding experiments were carried out with Mr. A. Millar, Estes Park, Salisbury. The management of these experiments reached a very high standard and the results obtained should be of definite value to farmers in this Colony. The one experiment on the effect of feeding on the firmness of the carcase has received wide publicity in Mashonaland and has done much to remove the impression that certain feeds such as meat meal, etc., caused soft fat. The experiments have been published in the Journal as follows:—

1. The Export of Frozen Porkers and Baconers and the effect of the level of protein feeding. *Rhodesia Agricultural Journal*—January, 1937.
2. The Effects of Feed on the Firmness and Grading of Bacon Carcases. Bulletin 1032—June, 1937.

(*c*) *Other Co-operative Experiments.*—No new co-operative experiments were started this year and all the existing ones were completed.

During 1936/37 further trials to determine the value of iron oxide as an addition to common salt under field conditions were carried out as follows:—

1. Rhodes Matopo Estate—Beef cattle.
2. Argyle Ranch, Beatrice—Beef cattle.
3. C. A. Kilburn, Trelawney—Dairy cattle.
4. C. J. Trichard, Brooklyn, Melsetter—Sheep.

In all casese there was no readily apparent benefit from the use of iron salts in addition to salt. These results confirm those obtained in 1935 and published in the annual report of this Division for that year, and appear to indicate that there are many conditions in this Colony where the expense incurred in feeding iron oxide in addition to salt is not justified.

There is need, however, for further investigation in view of contrary reports from other sources.

Sheep Industry.—Mr. R. H. Fitt, who is in charge of the sheep and wool work, was stationed at the Rhodes Matopo Estate for most of the year owing to the absence on leave first of the Chief Animal Husbandry Officer, and then of the Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate. Sheep work consequently did not receive as much attention as during the previous year. Authority has now been obtained to secure the services of a full-time Sheep and Wool Officer from April 1st next when the industry will have continuous supervision, especially on the Eastern Border.

Mr. Fitt reports that during the last year owners of flocks have taken a decided increased interest in the management and dosing of their sheep. This interest is apparently borne out by the figures of the losses from disease and poverty shown in the following table, as compared with previous years:—

1930—6,692	European sheep died from disease (probably entirely internal parasite).				
1931—6,963	,,	,,	,,	,,	,,
1932—6,570	,,	,,	,,	,,	,,
1933—5,161	,,	,,	,,	,,	,,
1934—4,392	,,	,,	,,	and	poverty.
1935—2,580	,,	,,	,,	,,	,,
1936—1,871	,,	,,	,,	,,	,,

Considerable work has been carried out in co-operation with farmers in the dosing of flocks and two large flocks in the Bulawayo district, which were badly infected by parasites, were cleaned up, as proved by *post mortem* examinations, during 1937. The dosing of these flocks was regularly supervised by Mr. Fitt, and goes to show that if properly applied the remedies now in use will effectively clean up a flock of badly infected sheep in Matabeleland.

In the body of his report the Sheep and Wool Officer makes the following comments:—

"(*a*) **General Condition of the Sheep on the Eastern Border.**—I have never at any time seen the sheep at Melsetter look as well as they do now. This is probably due to the very dry winter, which naturally would suit the sheep, but it is certainly to some extent due to better dosing and general management. I think that the time is drawing near when we can advocate culling for points other than weediness.

I have been advocating free range for the past two years, where free range is possible. This is, I think, beginning to take on more. I feel sure that free range would solve many of our problems in this area.

(*b*) **Romney Marsh and Merino Crossbreds.**—Mr. Olivy's crossbreds have been highly successful. The four tooth ewes are quite outstanding amongst the Merinos. There has been much less mortality in the crossbred lambs. Four of the crossbred ewes have just lambed, the first crossbreds to lamb so far. An outstanding feature is the large size of the udder, also the sturdiness of the lambs. Four tooth crossbred hamels fetched 37s. 6d. in Umtali, 17s. 6d. higher than the best Merino hamels.

(*c*) **Corriedale Rams.**—The new rams are holding their condition very well and commenced service almost immediately on arrival. This is a useful point and was not the case with the Romney Marsh rams.

(*d*) **Sheep Importations.**—During July I visited the Eastern Province with the purpose of purchasing sheep for farmers. The following animals were imported:—

85 purebred Blackhead Persians rams, 4 of which were registered stud animals.

228 purebred Blackhead Persian ewes.

4 purebred Corriedale rams.

1 purebred Ryeland ram.

5 Swiss goats.

Practically all these animals were re-distributed from Matopos School of Agriculture, many remaining at the School

for over two months. We had no mortalities, which goes to prove that if animals are well cared for when imported there should be little risk.

(*e*) **Cattle in the Melsetter District.**—Four years ago on the whole cattle management was on a par with the sheep management, which was exceptionally poor. To-day sheep management has gone far ahead of the cattle management, that is taking the district as a whole. Viewing the two best managed cattle herds and comparing them with the well managed sheep owned by the same men it is quite obvious that the cattle are doing infinitely better. After reviewing the four years that I have been closely connected with this area, I have come to the following tentative conclusions:—

(*a*) That Melsetter and Chipinga are better suited to cattle than sheep.

(*b*) That sheep, preferably a crossbred type such as the Romney Marsh-Merino crass can be made to do quite well if:—

i. Breeding is properly controlled.

ii. Dosing is done systematically.

iii. Free range (kraaling sheep is the cause of most of the troubles).

iv. Culling for constitution is done regularly.

(*c*) That cattle, if properly culled, breeding controlled and good bulls are used will do really well. This district has the advantage of being able to produce good fat stock off the veld during October to December, an invaluable advantage.

I have the feeling that there is an inclination among the good farmers of this district to turn from sheep to cattle, also I believe many of them will find the weaner proposition very attractive."

Feeding Experiment: Dairy Cows.

By W. M. Rennie, Mazoe Citrus Estate.

With a view to effecting economy in the feeding of dairy cows I have carried out experiments with orange peel, white stingless velvet beans and sunflower heads with moderately successful results.

The orange peel used experimentally was peel from which the oil and juice had been extracted by Citrus Products, Ltd. The nutritive value of this food was ascertained by the analyses of two samples sent to different firms in England for that purpose. The proximate principals were given by them in their respective reports as were the starch equivalent and food units.

On examining the digestible percentages of the food constituents of orange peel, I decided to carry out experiments in substituting this food for wheat bran in part and completely. Bran was then one of the three foodstuffs used in compounding our milk production ration.

The results of these experiments are best illustrated by the following tables of comparative values and the actual milk yielded during the experiment period.

TABLE 1.—COMPOSITION.

Composition of Rations.	Ground Nut Cake.	Bran.	Mealie Meal.	Orange Meal.	Quantity used per three gallons of milk expressed in lbs.
Original Ration... ...	1	1	3	—	11
Ration 1...	1	2	4	1	11
Ration 2...	2	—	4	3	10

TABLE 2.—NUTRITIVE VALUES AND COST OF RATION.

For the production of 3 gallons of milk.	Protein Equivalent.	Starch Equivalent.	Cost of production of 3 gallons of milk expressed in pence.
Recognised requirements	1.80	7.50	—
Original Ration	1.44	8.17	6.43
Ration 1	1.30	7.67	6.04
Ration 2	1.41	7.91	4.47

TABLE 3.—MILK YIELD.

	Cow No. 4 fed on Ration 1. Average daily production.	Cow No. 12 fed on Ration 2. Average daily production.	Factors influencing milk production.	Period of lactation used for experiment.
Week before experiment	17.93	31.43		Cow No. 4 154th day to the 203rd day after calving
1st week of experiment	17.93	29.64		
2nd ,, ,,	16.94	31.21		Cow No. 12 21st
3rd ,, ,,	16.50	30.94	No. 4 served	day to the 70th
1st week after experiment ...	17.14	30.73		day after calving
2nd ,, ,,	15.31	29.83	No. 12 served	
3rd ,, ,,	16.00	29.53	No 4 served	

In compounding the experimental rations I did not aim at increasing the production of milk. I considered the small cost of orange peel compared with that of other foods we use, and it was my object to prove orange peel a substitute for wheat bran, and consequently more economically valuable.

The maintenance ration remained the same throughout and neither of the two cows suffered any loss of condition. It can only be decided on the milk yielded whether orange peel proved a sufficient substitute for wheat bran.

The foregoing experiments were carried out in June, July and August of 1936. During the same period of 1937 I continued experiments with feeds. My intention being to effect further economy by partly substituting beans and sun-

flower heads for ground nut cake. For this purpose I used white stingless velvet beans and black sunflower seeds and heads. The tables of comparative values and milk production are given below.

TABLE 4.— COMPOSITION.

Composition of Rations.	Ground Nut Cake.	W.S. Velvet Bean Meal.	Orange Meal.	Mealie Meal.	Sunflower Meal.	Quantity used per 3 gallons of milk expressed in lbs.
Original Ration	1	—	—	3	—	11
Ration 3	1	2½	1½	1½	1½	10
Ration 4	1½	3	1½	3	—	10

TABLE 5.—NUTRITIVE VALUES AND COST OF RATIONS.

For the production of 3 gallons of milk.	Protein Equivalent.	Starch Equivalent.	Cost of production of 3 gallons of milk expressed in pence.
Recognised requirements	1.80	7.50	—
Original ration...	1.44	8.17	6.43
Ration 3	1.61	8.04	3.77
Ration 4	1.71	7.74	4.30

TABLE 6.—MILK YIELD.

	Cow No. 9 fed on Ration 3. Average daily yield.	Cow No. 34 fed on Ration 3. Average daily yield.	Cow No. 29 fed on Ration 3. Average daily yield.	Factors influencing milk yield.	Period of lactation used for experiment.
Week before experiment	39.44	27.93	26.85	No. 34 served	Cow No. 9 9th day to the 58th day after calving
1st week of experiment	37.14	26.43	26.71	Nos. 9 & 29 served	Cow No. 34 86th day to the 135th day after calving
2nd ,, ,,	36.44	26.30	27.35		
3rd ,, ,,	36.64	26.71	27.14		
1st week after experiment ...	35.80	27.30	28.00	No. 34 served	Cow No. 29 64th day to the 113th day after calving
2nd ,, ,,	38.80	27.14	28.21		
3rd ,, ,,	40.21	27.35	27.71		

TABLE 6.—MILK YIELD.

	Cow No. 14 fed on Ration 4. Average daily yield.	Cow No. 15 fed on Ration 4. Average daily yield.	Cow No. 33 fed on Ration 4. Average daily yield.	Factors influencing milk yield.	Period of lactation used for experiment.
Week before experiment	29.16	43.73	40.09		Cow No. 14 183rd day to 239th day after calving
1st week of experiment	30.02	39.73	38.60	No. 15 served	
2nd ,, ,,	31.64	41.07	39.60		Cow No. 15 99th day to the 155th day after calving
3rd ,, ,,	32.50	42.21	41.30		
4th ,, ,,	32.71	43.14	40.86		
1st week after experiment ...	31.73	42.57	39.58		Cow No. 33 47th day to the 101st day after calving
2nd ,, ,,	30.22	43.02	39.20		
3rd ,, ,,	28.85	40.21	39.61	No. 14 in calf.	

Once again the maintenance ration remained the same and success, or lack of it, in achieving my object can only be estimated on the actual quantity of milk yielded. I consider that it was satisfactory.

Milk yielded was weighed twice a day and can be taken as being correct.

Production requirements are figures advocated by the Ministry of Agriculture, England.

Protein and starch equivalents are based and worked out on the digestible percentages of food constituents only.

Very little can be said about the experiments themselves as the tables give most of the information. However, orange peel is not a particularly palatable feed and is only taken readily after the animals have become used to the taste.

Foodstuffs were used in the form of meal, and I should like to state that it is difficult to effect economy and at the same time completely balance a ration when there is only a limited variety of foodstuffs available.

Annual Report of the Division of Entomology

FOR THE YEAR ENDED 31ST DECEMBER, 1937.

By RUPERT W. JACK, Chief Entomologist.

AGRICULTURE.

(1) **Locusts.**—The Red Locust (*Nomadacris septemfasciata* Serv.) has been present in the Colony throughout the year in swarm formation, but the numbers were relatively small. The damage to crops generally was not as extensive as in previous years, injury to crops and early grass being reported from a few districts only. Breeding during the wet season of 1936-37 was confined to several localities in the low veld. During the dry season swarms gradually infiltrated into the Colony and egg-laying was reported in several localities in the Mazoe and Lomagundi districts during the last few days of December. The Department is well equipped to deal with any outbreaks which may occur. However, widespread hatching of hoppers is not anticipated, but there are signs that breeding may take place in the Colony on a larger scale than during last wet season.

During the year many reports of storks and kites following swarms have been received. Insect parasites, however, were scarce compared with former years.

Provisional agreement has been notified in connection with a project put forward by the Committee on Locust Control of the Economic Advisory Council in Great Britain for permanent international control of the Red Locust in its permanent breeding grounds, some of which have been identified in several restricted localities in Northern Rhodesia and Tanganyika Territory.

(2) **Pests of Growing Maize.**—Stalk-borer (*Busseola fusca*, Full.) was not reported as a pest during the year. Outbreaks of Army Worm (*Laphygma exempta*, Walk.) were reported

from several localities in January and March, and from the Salisbury, Hartley, Lomagundi and Mazoe districts in late December, and the young maize crop in some localities sustained extensive damage. Other pests of young maize were as follows:—

The snout beetles, *Tanymecus destructor*, Mshl. and *Systates exaptus*, Mshl., caused severe injury in the Salisbury, Hartley and Mazoe districts during December. Some damage by the beetle, *Exora discoidalis*, Jac., was reported from the Salisbury district. In one locality in the Lomagundi district caterpillars of the small moth *Marasmia trapezalis*, Guen., (Pyralidae) injured the leaves. Maize planted in land which had been green-manured with sunnhemp (*Crotalaria juncea*, L.) was severely attacked in the roots and germinating seed by a Curculionid beetle* larva in December in the Salisbury district. The effect of the use of sunnhemp as a green-manuring crop on the incidence of insect pests is a problem which must be studied closely by the Department, as there is some evidence that unfortunate repercussions may result in so far as the increase of destructive species of beetles which breed in the soil concerned.

(3) **Pests of Growing Tobacco.**—(*a*) **Root Gallworm** (*Heterodera marioni*, Goodey).—Reports of extensive injury to tobacco, both in the seed-beds and in the field by this pest, possibly as a result of the early rainfall of the last season, have been received from the Umvukwe area. The control and eradication of root gallworm is of the greatest importance to the industry, and it is satisfactory to note that an officer of the Tobacco Research Station at Trelawney has been appointed to investigate the problem.

(*b*) **Tobacco White Fly** (*Bemisia rhodesiaensis*, Corb.).—The incidence of this pest, the vector of "leaf-curl" disease, is decreasing as a result of the enforcement of the law concerning the removal of tobacco plants from the fields after the harvest in the late dry season. White Fly was found only on a few farms in Mashonaland.

(*c*) **Sand Crickets** (*Brachytrypes membranaceus*, Dr.).—In the Salisbury district sand crickets continue to be a pest of newly transplanted tobacco. Poison baiting, using a

***Systates exaptus*, Mshl.

moistened mixture of barium fluosilicate and maize meal (1:40), was carried out in one locality in an attempt to limit the infestation in the fields immediately prior to planting out, and a moderate degree of control was effected. It should be noted, however, that eradication of this pest from fields by means of poison bait is not possible owing to the subsequent reinfestation of fields which takes place during the rainy season. Control methods need to be continued from year to year.

(*d*) **Other Pests of Tobacco.**—The surface beetle, *Gonocephalum simplex*, F., severely injured the stems of newly-planted out tobacco in some localities in the Salisbury district, particularly in low-lying fields. The beetle recorded as a species of *Protostrophus* in my Annual Report for 1936, has now been identified as *Analeurops cuthbertsoni*, Mshl., and it has been found injuring the leaves of young tobacco plants in early December near Salisbury. Leaf miner (*Phthorimaea operculella*, Zell.) and stem borer (*P. heliopa*, Lw.) were present in the early part of the year, but no extensive damage by them has been reported. Tobacco aphis, or "green fly" (*Myzus persicae*, Sulz.) heavily infested some fields of Turkish tobacco during March and April in the Darwendale area, the early cessation of the rains bringing about favourable dry conditions for their breeding. Some damage to young tobacco by grasshoppers was reported in December from the Tobacco Research Station near Trelawney. Promising results with a moistened mixture of barium fluosilicate and maize meal broadcast on seed-beds as a poison bait for cutworms (*Euxoa segetum*, Schiff.) has been reported by a farmer in the Salisbury South area.

(4) **Pests of Leguminous Crops.**—(*a*) **Sunnhemp.**—The leaf-eating beetles, *Exora discoidalis*, Jac., and *E. apicipenn*, Jac. (Galerucidae) were responsible for much damage to the seedling crop in early December in the Mazoe and Salisbury area, and extensive areas had to be re-sown as a consequence of their attacks. The late sown crop appeared to suffer much less injury, and it is possible that by delaying the time of sowing until after the mass emergence of these beetles in early December, a satisfactory stand may be obtained.

(*b*) **Dolichos Bean** (*Dolichos Lablab*, L.) pods were severely infested with American bollworm (*Heliothis obsoleta*, F.) during April in the Salisbury district. Young plants were attacked by the beetle *Systates exaptus*, Mshl., in late December near Salisbury.

(*c*) **Cowpeas** (*Vigna*) and **Soya Beans** (*Glycine*) were injured by the leaf-eating *Ootheca mutabilis*, Sahlb. during late December in the Salisbury district.

(5) **Pests of Cotton.**—The following notes on the incidence of cotton pests have been kindly contributed by the Plant Breeder in charge of the Cotton Station, Gatooma:—

"The year saw the passing of the Cotton Pest Prevention Act, 1937, prohibiting the practice of ratooning cotton plants, and of allowing them to stand over from one growing season to the next. It is designed to prevent the spread of cotton stainers and Sudan bollworm. It is hoped that the enforcement of this measure will not only prevent the spread of Sudan bollworm (*Diparopsis castanea*, Hmp.) but, in some areas, will reduce it to the position of a minor pest. The season has been a bad one from the point of view of damage by stainers (*Dysdercus* spp.) but a considerable part of the damage resulted from a spread from areas of ratooned cotton. The enforcement of the Cotton Pest Prevention Act will reduce the amount of such staining. In most years attack by American bollworm (*Heliothis obsoleta*, F.) is the most important single factor affecting the crop; but this past season it has been comparatively unimportant, and secondary to other factors, *viz.*, stainer damage, and the February to March period of drought. As a result of the favourable early seasons, a fair portion of the crop had matured before the occurrence of extensive egg-laying by American bollworm moths at the end of February. A very interesting feature of the season has been the attractiveness of dolichos beans to ovipositing American bollworm moths. It has been a year of very mild attack of jassids (*Empoasca facialis*, Jac.) even susceptible strains yielding well, but the breeding of strains of high resistance to jassids is one of the primary considerations in the selection and breeding work."

(6) **Pests of Citrus.**—The following notes on the incidence of pests has been kindly contributed by the Director of the B.S.A. Company's Citrus Experimental Station at Mazoe.

"Citrus was free from any serious outbreaks of insect pests during the year. The mild attack of the American or cotton bollworm (*Heliothis obsoleta*, F.) was no doubt attributable in part to the severe winter. One of the lighest attacks on record of the citrus thrips (*Scirtothrips aurantii*, Faure) was experienced, and this was somewhat unexpected in view of the high temperatures of October and November, and the absence of rain. The citrus aphis (*A. tavaresi*, del.G.) gave very little trouble, and no swams of Red Locusts were encountered. Infestation by red scale (*Aonidiella aurentii*, Mask.) was much the same as usual, and losses were negligible where adequate control measures were practised."

(7) **Pests of Fruit other than Citrus.**—The chafer beetles, *Anomala exitialis*, Per. and *A. pinguis*, Per. defoliated and damaged the blossoms of apple trees during October in the Marandellas district. The leaf-eating beetles, *Adoretus testaceus*, Bhn. and *Trochalus sp.*, and a beetle *Corimosphena fasciculosus*, Per. (Tenebrionidae) severely injured apple foliage during November in Makoni district. Woolly aphis (*Eriosema lanigerum*, Hausm.) was found during November on some imported apple trees in the Salisbury district. Caterpillars of the moth, *Parasa latistriga*, Wlk., injured the leaves of plum trees during June in the Marandellas district. An unidentified blister mite was reported during November as injurious to pear foliage in the Inyanga district.

(8) **Pests of Vegetables and Garden Plants.**—Bagrada bug (*B. hilaris*, Burm.) was a pest during July and August of cabbages and other cruciferous crops in several localities. The diamond back moth (*Plutella maculipennis*, Curt.) and the cabbage aphis (*Brevicoryne brassicae*, L.) were very injurious to cabbage during the late dry season in the Salisbury district. In the same district an unidentified aphid was reported as a pest of globe artichokes during December. The chafer beetles, *Anomala exitialis*, Per., and *Adoretus testaceus*, Bhn., caused much damage to the foliage of rose trees during November and December. The gladiolus stem-borer (*Epimadiza hirta*,

Mall.) and an unidentified "yellow thrips" caused considerable injury to gladiolus plants during November in the Salisbury district. Caterpillars of the moth, *Brithys pancratii*, Cyr., severely injured the stems of amaryllidaceous plants during February at Salisbury.

(9) **Termites Infesting Buildings.**—Some of the termites, or "white ants," which have been reported during the year destroying wooden structures in buildings have been identified as follows:—*Termes badius*, Hav., *T. pauperans*, Silv. and *T. transvaalensis*, Sjöst.

(10) **Pests of Stored Products.**—(*a*) **Tobacco.**—Owing to the continued hygienic methods and early and complete disposal of crops, the position on farms and in warehouses as regards the stored tobacco worm (*Ephestia elutella*, Hubn.) and the tobacco beetle (*Lasioderma serricorne*, L.) remains satisfactory.

In a large factory there has been a decided improvement. This is attributed mainly to the continued reduction of old stocks of unpapered bales of Virginia tobacco, and the practice of introducing only tobacco that has been conditioned in a Proctor machine and properly baled and wrapped in tar-impregnated paper. This practice is strongly recommended to other manufacturers. Farm-packed bales which are brought direct from the auction floors are not in a good condition to escape insect attack.

Supplementary control methods practised are (1) strict observance of cleanliness, (2) the whole-time employment of natives catching or searching for Ephestia, and (3) smearing all store-room windows with engine oil. The oil is sticky and catches *Ephestia* and *Lasioderma*, both of which tend to fly to the windows in the late afternoon and possibly in the morning.

Turkish tobacco, which may neither be "proctored" nor wrapped in paper, is isolated in a separate store-room and subjected to the above supplementary methods, plus the hanging of many sticky fly-bands over the bales.

(*b*) **Maize.**—An unusual infestation of maize weevil (*Calandra oryzae*, L.) occurred during the winter. Investigations indicated that the outbreak was due to the early drying of the grain in the field, resulting from the early cessation of

the rains. Early drying brought about early attack by weevil. The final effect was, however, a subnormal infestation in the spring, as the grain had by this time dried out to a degree unfavourable to the extensive breeding of weevil.

The study of environmental conditions in a maize stack has led to experiments in control of maize weevil by minimising the loss of heat from the outside bags of a stack. The work has been hampered for the past two seasons by illness and by the difficulty of obtaining the use of a suitable stack for more than comparatively short periods. However, some promising results are indicated.

(11) **Miscellaneous Insects Records.**—The following insects and their host plants are worthy of record. Some of the records are the results of observations made during the year, and others are records held over from previous years, pending authentic identification of the insects:—

(*a*) The moth, *Hapalia ablactalia*, Wlk. (Pyralidae) whose caterpillars infest the fruits of Zimbabwe Creeper (*Podranea brycei*, Bignoniaceae) during March.

(*b*) The moth, *Acrocercops scalariella*, Zell. (Gracilaridae) whose caterpillars defoliate the garden plant, *Anchusa capensis* (Boraginaceae) during March.

(*c*) The beetle, *Dinoderus minutus*, F. (Bostrychidae) whose grubs bore in the cut stems of an indigenous bamboo (*Oxytenanthera abyssinica*) during September.

(*d*) The beetle, *Bagous longulus*, Gyll. (Curculionidae) which injures the leaves of water lilies (*Nymphaea*) during February.

(*e*) The beetle, *Blosyrus ipomoeae*, Mshl. (Curculionidae) which injures the leaves of sweet potatoes (*Ipomoea*) during April.

(*f*) The fruit fly, *Pardalaspis bipustulata*, Bez. (Trypetidae) whose maggots infest the fruits of a wild plant *Capparis ?tomentosa*, Lam., during March.

(*g*) The fly, *Atherigona nudiseta*, Mall. (Anthomyiidae) whose maggots injure the stems of Rhodes Grass, *Chloris gayana*, during February and March.

(*h*) The small ant, *Acantholepis capensis*, Mayr., var. *incisa*, Forel, which sometimes infests houses in Salisbury, and sometimes attends mealy bugs (*Pseudococcus*) and Australian bugs (*Icerya purchasi*) on citrus trees during December.

MEDICAL AND VETERINARY.

The following report on the tsetse fly operations has been contributed by Mr. J. K. Chorley, who is in immediate control of this undertaking.

I will only remark that one of the greatest problems in connection with the reclamation of country from tsetse fly is the utilisation and consolidation of the areas reclaimed. This problem is particularly difficult in Southern Rhodesia, where the country concerned is mostly unsuitable for European settlement and incapable of supporting any considerable native population. Furthermore, it appears that at present there is very little demand for fly-free areas for native occupation.

Large areas, when cleared of fly, are therefore available as temporary sanctuaries for game. It appears that there is a conspicuous opportunity in the present stage of development of the Colony to get rid of tsetse fly altogether, and still to retain the game. The plan consists of a slowly advancing wave of game reduction operations combined with game sanctuaries established in the areas cleared of fly. Local undertakings of a different nature may be found necessary and feasible to avoid reducing rhinoceros, and perhaps other species, beyond the recovery point. Elephant and rhinoceros would not be molested in the first place, at least until with the result of breaking contact between the fly and other species of game became apparent. Presuming sufficient localisation of the fly in contact with rhinoceros or other species, the feasibility of the application to limited areas of the results obtained by research on tsetse fly both in other parts of Africa and in this Colony could be explored.

This appears to be the logical policy in the Colony at the present time in view of the experience gained in eliminating *morsitans* by controlled operations against the game.

By Mr. J. K. Chorley.

The destruction of game as a defensive measure against the encroachment of the tsetse fly *Glossina morsitans* in Southern Rhodesia was first adopted as an experiment in the

Wankie district in 1919. The results of this experiment were entirely satisfactory, the fly was driven back north of the Shangani River and animal trypanosomiasis, the disease carried by the tsetse, was eradicated from the Gwaai Valley. When, in 1925, the slowly expanding northern fly belt began to invade settled areas, in the Umboe and Sipolilo areas of the Lomagundi district, causing heavy losses of both European and native owned stock, it was decided to apply the same measures that had proved successful in the Wankie district, but reinforced by the erection of game fences where the pressure of the invasion was greatest and where immediate results were required.

Evidence that satisfactory results were being obtained was rather slow in making itself evident, partially because of the nature of the country involved, which was particularly favourable to both fly and game, and partially owing to the cryptic nature of the disease amongst stock not subject to repeated infection. Native cattle possess some degree of resistance to trypanosomiasis and numerous natural recoveries have been observed. Animals which have recovered may "break down" at a later date if subjected to adverse conditions or are over-worked, or if they contract some other disease. In such circumstances, deaths may occur many miles from the site of infection, and even years after the disease was originally contracted, trypanosomes being present in the blood stream at death. Increasing pressure of the tsetse in other areas (notably the Gatooma area, in 1926, where game destruction and fencing were immediately applied) necessitated in 1929, in the absence of other known and proved control measures, the application and extension of game destruction over the whole fly front wherever the ever-extending fly belt was beginning to invade new ground. The land being invaded during these years was about 1,000 square miles per annum, and the prospect of losing much occupied land, with its train of ruined and disillusioned farmers, of economic loss and the destruction of forty years of endeavour was imminent.

Happily these prospects did not mature. The policy of controlled and intensive game destruction with the object of creating a game free buffer zone between the fly and settlement has proved successful in stopping the advance of the fly in all

the areas where it has been applied. Furthermore, not only has the immediate object of stopping further advances been gained, but it has been found possible in practice to recover ground. The experimental stage has passed. To-day it is a proved measure which can, with confidence, be applied in any area on the periphery of a fly belt wherever land is required for European or native development.

The cost, both financial and ethical, has been great, and is an ever mounting total, and the question of how far we shall bite into the fly belt reclaiming land for which at the moment there is no immediate want is one which will soon demand an answer. It may be asked what are the immediate objectives of the present policy? Stated briefly, they are:—

(*a*) In the northern districts to drive the fly below the escarpment and to reclaim the Urungwe Native Reserve.

(*b*) In the Hartley, Sebungwe and the south-western portion of the Lomagundi districts to drive the fly back to a line running roughly from the south-western beacon of the Urungwe Native Reserve to a point north of Gokwe in the Sebungwe. In effect, to reclaim the whole of the old Mafungabusi-Hartley fly areas based on the Umfuli and Umniati Rivers. This area would include the recent sleeping sickness area at Gowe and the mining district around the Emerald and Copper Queen Mines. It is expected that this objective will be achieved within the next few years. Much progress has already been made.

(*c*) In the Wankie, Bubi and Sebungwe districts to drive the fly some fifteen to twenty miles north of the Shangani River, and thus protect the Wankie Game Reserve from invasion and permit farming operations with a stock along the Gwaai and Shangani Rivers. This objective has nearly been achieved to-day.

There is a possible alternative to this policy. It is thought that the tsetse can be eradicated from the whole of the fly areas by a judicious and cautious extension of our present policy of game destruction, advancing by a series of wave assaults covering a period of years, and that this could be accomplished without exterminating the game in any of the districts concerned.

Concomitantly, a policy of rigid game protection would have to be enforced in the areas cleared and thought to be safe from re-invasion by the tsetse. In certain areas in the low veld where elephant and rhinoceros are abundant, other measures might have to be employed such as bush and thicket clearing. In the first place, these animals would not be shot, as it is thought that they could not recover if shot out of any given area. These remarks apply particularly to rhinoceros, which cannot be driven, are very localised and remain for years based upon a few favoured water-holes.

In several districts large areas have been closed to free shooting during the past two years, and the game has rapidly increased in these areas. In the Lomagundi district, in an area closed to free shooting two years ago, requests have been received from the Farmers' Associations to declare kudu vermin. Fortunately the area which it is suggested might be cleared of tsetse by the measures outlined, lie outside the zone of European settlement, and little mining activity either for base or precious metals is likely to develop.

The utilisation of these reclaimed areas, which may eventually be in the neighbourhood of some 6-7,000 square miles, is a problem which will require much thought and is one which will bring many other problems in its train. It is one bound up with the rate of development of the country as a country of progressive white civilisation, of native land settlement and tenure, and with minor but essential problems connected with the provision of water, dip tanks, money-crops, roads, etc.

Already some progress has been made in the Wankie district in settling natives in the Mabale Valley, a tributary of the Gwaai River, and a dip tank is being provided from funds supplied by the Agricultural Department which has, in conjunction with the Roads Department, provided water. Similar provision may have to be made in the Doma area where a further 300 square miles has been cleared of fly, and the introduction of stock will shortly be sanctioned, also in Lomagundi, S.W., including the Magondi Reserve. The poorly watered and infertile area west of Gatooma is a par-

ticularly difficult problem, but once the two main river systems are cleared of fly, native settlement along the rivers may increase.

During the year a further 1,500 square miles of land has been reclaimed which, with the 2,500 square miles mentioned in last year's annual report, makes a total of approximately 4,000 square miles. The greater portion of this area is either Crown land or Native Purchase Area, which makes the creation of any permanent scheme of native settlement very difficult.

This large area is accounted for by the fact that in the Wankie district the tsetse is intimately connected with the river systems and does not permanently occupy the "Gusi" forests on the Kalahari Sand. Similarly, in the Lomagundi district, close to the escarpment, tsetse was restricted to the river systems and did not infest the broken arid and mountainous country forming the escarpment. For all practical purposes these areas are considered as infested—there were no cattle there and no cattle could be introduced. They are shown as infested on our maps.

On the Eastern Border it is disappointing to have to report that a number of cases of trypanosomiasis occurred during the year on farms adjacent to the border. Most of the farms concerned are in the basin of either the Inyamadzi or Chiredza Rivers, or are connected by a forest belt with these two river basins. Consequently, further clearing work was undertaken at the junction of these two rivers where they cross the border, the clearing being made approximately three-quarters of a mile wider at this point. The original clearing was maintained, all re-growth being slashed back and an exceptionally good burn was obtained in October.

A further spread of *G. morsitans* in Portuguese East Africa towards the border was recorded during the year, a number of flies being captured in the Busi Valley, at a point not more than five miles from the border clearing. An apparent increase of *G. morsitans* appears to have occurred on the Chibabava Road below Spungabera, the Portuguese Administrative post of the Mossurise district. The threat of an invasion of the lower end of the Melsetter district by this fly at some

future date has definitely increased during the year and the matter is the subject of serious consideration at the present time.

Arrangements are being made for the conveyance of alien natives by motor lorry from the food depot on the M'Kumvura River to Darwin during the dry season. This route is clear of fly, and there is no danger of sleeping sickness being introduced into the Zambesi Valley fly areas along this route, but the main alien paths in the Sipolilo and Miami districts pass through many miles of dense fly, and the danger of such an occurrence happening is real.

During the year certain economies have been effected in the reduction of native hunters and in the expenditure of ammunition.

1. **Darwin.**—The natives continue to show confidence in the success of the operations by introducing more cattle into the Kandeya Reserve, and by placing cattle at kraals close to the Masongerera and Kapanda footpaths. They still show reluctance to place cattle in the vicinity of the Nyamarapara Path, at which chamber a number of flies are caught. These flies are brought up from the low veld from an area outside the zone of our operations. The number of native hunters has been halved, as it is not proposed at present to do more than maintain the present position in the Darwin district.

2. **Sipolilo.**—An isolated case of trypanosomiasis occurred in a bull running with some native stock north of the Dande River. Individual cases of this description can be expected in this area as there are no cleansing chambers on the main footpaths from the Zambesi Valley and occasional flies may be carried up the escarpment by pedestrians. It is not considered necessary to erect chambers until such time as the broken country near the escarpment is required for settlement. The position remains satisfactory, though no resusciation of farming activity is taking place in the European areas along the Hunyani River cleared of fly some years ago.

3. **Lomagundi (Doma).**—The operations in this area have yielded most striking results during the past few years and the ultimate objective of the operations, namely, the driving back of the fly below the escarpment, appears to have been achieved during the present year. A density count carried out late in the season indicates that the river systems north of the northern fence and as far as the escarpment are now cleared of fly. In this broken country a few rhinoceros still survive, but being protected, it was thought that their presence might delay the clearing up of this area. It is possible that the activities of the native hunters has changed their habits and prevented them from remaining in the vicinity of their favourite water-holes and in consequence eliminating them as a source of food for the few tsetse which persisted around these water supplies.

More native cattle have been introduced into the southern fenced zone, making a total of slightly over 1,600 head. These herds have been carefully inspected each month, and no cases of trypanosomiasis have occurred. If future surveys confirm the present position, cattle will be allowed into the northern fenced zone during the coming year. The area cleared of fly between the northern and southern fences amounts to approximately 600 square miles, while a further 500 to 600 has been cleared between the northern fence and the escarpment, making a total of some 1,100 square miles. These are concrete results achieved with the minimum of that costly scientific control so greatly prized by some workers elsewhere.

4. **Urungwe.**—A slight improvement has taken place in the vicinity of Manyangau Hill and the new mica claims which are being opened up north of the Mkwichi River. A few rhinoceros and a small herd of elephant are based on this river, but our operations north of Manyangau appears to have reduced the density of fly in the broken and arid country to the north. This reduction of fly density is reflected in the few flies caught at the Manyangau cleansing chamber. The fly position elsewhere in the area remains much as last year. Two flies, presumably carried from the western side of the Reserve,

were caught in the vicinity of the Ranger's Camp, but for the first time for many years no cases of trypanosomiasis have been reported. A new large cleansing chamber has been erected at Vuti to deal with the large lorries with trailers transporting material to the Otto Beit Bridge over the Zambesi River at Chirundu. With the completion of this bridge and the construction of good roads, a large increase in traffic to and from the north is expected. The opening up of the Zambesi Valley has already caused considerable changes in the game population, and may eventually cause changes in the distribution of the fly. This change is already reflected in the reduced number of flies caught at Vuti cleansing chamber.

5. **Lomagundi, S.W.**—This area may be considered as part of the Hartley fly area north of the Umfuli River. During the year the few fly which long persisted on the lower end of the Umfuli River have been reduced to vanishing point, only two flies having been caught during the year. A corresponding clearance of tsetse from the Hartley side of the Umfuli has been achieved. If desired, cattle could now be introduced into the Magondi Reserve.

6. **Gatooma.**—During the year further progressive gains have been made in this area. With the exception of a small area around the Seki-Sakugwe junction, where an occasional stray fly may still be found, tsetse has been completely eradicated from the twenty mile buffer zone west of the eastern game fence. In July, the operations were extended to the Sebungwe district. In this new area fly exists on the Umniati River from just north of the Rhino Mine to a little north of the Nyhondi River, but disappears some miles south of the Umfuli junction. A few fly are also present on the Renje, Sakugwe and Nyhondi Rivers, small tributaries of the Umniati on its eastern bank, but nowhere in the area does the density of fly exceed five per boy per hour. This area includes the old sleeping sickness centre at Gowe, and the whole of the area was very heavily infested in the immediate past. Tsetse appears to have disappeared or been considerably reduced in the vicinity of the Emerald and Copper Queen Mines.

Owing to the complete eradication of fly from the Rob's Drift Road, the cleansing chamber at Gambeza was closed down in August. The area cleared of fly in this area is

estimated to be 1,200 square miles, which, together with the 300-400 square miles cleared north of the Umfuli River, makes a total of some 1,600 square miles.

7. **Gwaai-Shangani Area.**—A further progressive improvement has to be reported from this area during the year north of the Shangani River and more particularly on the Kana River. A fly survey carried out at the end of the dry season indicates the complete eradication of fly from the northern bank of the Shangani River and also from the Kana and Tshongokwe Rivers. The present limit of fly appears to be a line drawn from Mbobos Kraal to the pan on the Mzola River some fifteen miles above its junction with the Shangani River, thence eastward along the Kalahari sand watershed between the Kana and Mzola Rivers, *i.e.*, fly has been eradicated, or nearly so, over a strip roughly eight to twenty miles wide north of the Shangani River. About 700 square miles has been cleared to date.

The dip tank at Macheya is being re-opened, and native settlement with cattle along the Shangani River may be intensified. In the Mabale Valley, south of the Gwaai River, native settlement is taking place under the direction of the Native Department, a dip tank being provided by the Agricultural Department.

A few more cattle have been introduced on to the Gwaai Settlement farms and no cases of trypanosomiasis have been reported. The threat of tsetse invading the Wankie Game Reserve and the Shangani Native Reserve has been eliminated.

Traffic Control.—The cleansing chamber on the Rob's Drift Road was closed down in August, leaving five cleansing chambers, as compared with thirteen some six years ago. These stations are situated as follows:—One in the Wankie district on Walker's Road, two in the Miami district and two in the Darwin district. The regulations for the control of traffic in the Wankie district have not been strictly enforced during the year, as no further pegging of tin and tungsten claims has occurred within the fly area, and no traffic has developed. The station on Walker's Road has been maintained, as it was expected that this road might be opened up as an alternative route to the mining area north of the Gwaai River. This has

not eventuated, although a few cars have crossed Shangani River to visit the hot springs at Luvimbi. If possible this road will be opened up to the Zambesi River during the coming year. A large cleansing chamber has been erected at Vuti to deal with large motor lorries transporting material to the new bridge across the Zambesi River at Chirundu, and was brought into commission during August.

The details of traffic dealt with at the cleansing chambers is as follows:—

1. **Rob's Drift Road, Gatooma.**—Sixty-nine motor cars, four hundred and twenty cyclists and five hundred and six pedestrians (553 parties) bringing no flies.

The number of flies caught at this station in past years were: 1931 (687); 1932 (377); 1933 (498); 1934 (478); 1935 (36); 1936 (9). The last fly caught off cars was in December, 1936, and off pedestrians in August, 1935. This chamber was closed at the end of August.

2. **Miami-Zambesi Road.**—(*a*) *Vuti Chamber.*—Six hundred and forty-four (644) motor cars bringing eighty-three (83) flies (48 male, 35 female), four thousand seven hundred and thirty-five (4,735) pedestrians, two hundred and sixteen cyclists (216), (846 parties) bringing one hundred and fifty-eight (158) flies (93 male, 65 female). Total two hundred and forty-one (241) flies (141 male, 100 female).

Compared with 1932 (106); 1933 (94); 1934 (178); 1935 (454); 1936 (519).

(*b*)- *Manyangau Chamber.*—Five thousand and twenty-seven (5,027) pedestrians, two hundred and fifty-seven (257) cyclists, (897 parties) bringing eighty-eight (88) flies (49 male, 39 female).

Compared with 1935 (296); 1936 (401).

3. **Walker's Road.**—Thirty-two (32) motor cars, six hundred (600) pedestrians, six (6) cyclists (275 parties) bringing no flies.

Compared with 1932 (4,180); 1933 (989); 1934 (551); 1935 (59); 1936 (4).

The last fly caught off a motor car was in October, 1936, and off pedestrians in January, 1936.

4. **Darwin.**—(*a*) *Nyamapara Path.*—Two thousand seven hundred and eighty-one (2,781) pedestrians and eighty-one (81) cyclists (644 parties) bringing forty (40) flies (27 male, 13 female).

Compared with 1932 (112); 1933 (97); 1934 (85); 1935 (161); 1936 (403).

(*b*) *Kapanda Path.*—Two thousand seven hundred and seventy-seven (2,777) pedestrians, eighty-two (82) cyclists (745 parties) bringing three (3) flies (1 male, 2 female).

Compared with 15 flies for six months in 1936.

Melsetter Border.—The good results at first obtained from the border clearing were not fully maintained during the year under review, as a number of cases of trypanosomiasis occurred on four border farms. There were sixty suspected cases with thirty odd deaths. As an additional precautionary measure the clearing was made nearly a mile wider at the junction of the Inyamadzi and Cheredza Rivers. All re-growth on the old clearing was slashed back and a very clean burn was obtained in October, the grass being dry after early winter frosts and thick, owing to the poor burn in 1936. Three specimens of the tsetse *Glossina morsitans* were caught on the Busi River at the Gogoyo Road, a point which is not more than five miles from the border clearing on the Inyamadzi River. A rapid survey of the tsetse position in the northern Mossurise district close to the border was carried out during the year. Measures to prevent this species of fly from invading the Colony are under consideration.

Tsetse Fly Research.—Laboratory research in reference to the physiology and behaviour of *Glossina morsitans*, West. has been continued intensively throughout the year. An ample supply of wild pupae of this species has been maintained and much information of a potentially useful nature has accumulated.

It was the intention at the end of last year to produce a progress report on the work accomplished, but in the absence of statistical assistance and in face of the necessity of con-

tinuing the experiments, it has not been found possible to complete such a report, although considerable progress has been made in tabulating and writing up results. A letter on the method of estimating the water content of tsetse flies was published in *Nature* in January, and a short paper of a preliminary nature entitled "The Effect of Temperature on the Reaction of *Glossina morsitans*, West. to Light" appeared in the *Bulletin of Entomological Research* for October.

A great disappointment was sustained in connection with the project to extend the scope of the research to *Glossina pallidipes* and possibly *G. brevipalpis*. Through the courtesy of the Governor of the Mocambique Company's Territory permission was obtained to despatch a pupae collecting party to the Mossurise district of Portuguese East Africa. This party was in charge of a tsetse fly ranger who had successfully maintained the supply of *morsitans* pupae from the Lomagundi district. Unfortunately, it appears that in the type of country concerned the breeding sites of *pallidipes* and *brevipalpis* are not sufficiently differentiated for considerable number of pupae of these species to be collected, and after about three months the party was recalled. I understand that similar difficulties have been experienced with these species in other parts of Africa.

Comparisons between the reaction to meteorological factors of different species of *Glossina*, each adapted to a different environment, would undoubtedly have added greatly to the value of the research work, and the failure to obtain a supply of species other than *morsitans* is greatly to be regretted.

During the year 42,399 pupae of *morsitans* have been received at Headquarters and 15,961 flies have been bred out.

It is not proposed that intensive laboratory work on *morsitans* should be continued beyond the end of the present financial year, but arrangements have been made for an ecological and eco-climatic study during the coming dry season of the country around Chipane, in the Lomagundi district, which has supplied the pupae for laboratory work during the past two years.

Trypanosomiasis Committee.—All meetings of the Trypanosomiasis Committee throughout the year have been attended by one or more members of the Entomological Branch.

Flies of Medical and Veterinary Interest.—Two species of small midges, *Simulium nigritarsis*, Coq., and *S. pseudomedusaeformis*, De Meillon, have been found to breed during July in the River Makabusi near Salisbury. The breeding habits of some common flies have been investigated, and several carnivorous species of Dipterous maggots, including those of *Dimorphia flavicornis*, Macq., have been found to prey upon the maggots of house-flies, including *Musca interrupta*, Walk., and *M. lusoria*, Wied., in cattle dung.

Tick Survey.—The Bont Tick (*Amblyomma hebraeum*, Koch) the vector of heartwater disease of cattle, has increased its range northward from Matabeleland to the Gwelo and Hartley district. The spread of this tick is causing concern to the Department.

Bed Bugs (*Climex lectularius*, L.) **in Native Quarters.**—Experiments in the control of bed bugs in native quarters built of plastered brick are giving promising results. The attempted control consists of restricting the bugs to the lower parts of the room by means of barriers and shelters, and killing them regularly by heat from a blow lamp.

The Insect Collection.—The following numbers of insect species were identified by the Museums and other Institutions named:—

The Imperial Institute of Entomology, London: 74;

The American Museum of Natural History, New York, U.S.A.: 24;

Instituto Oswaldo Cruz, Rio de Janeiro: 9;

The South African Institute for Medical Research, Johannesburg: 10;

The Department of Agriculture and Forestry, Pretoria: 9; and the

National Museum of Southern Rhodesia, Bulawayo: 22.

More than one hundred and sixty species of insects were sent for identification to specialists in Africa and overseas during the year.

A large number of insects, including the types or paratypes of species new to science were presented to the following institutions:—

The British Museum (Nat. Hist.) London;

The School of Tropical Medicine, Liverpool;

The American Museum of Natural History, New York;

Harvard University, Boston;

The State College of Massachusetts, Amherst;

The University of Wisconsin, Madison;

Instituto Agronomica, Campinas, Brazil;

The South African Institute for Medical Research; and

The National Museum of Southern Rhodesia.

The collection of insects made by the late Major J. E. Drysdale, in the Umtali district, was presented to the Branch by the Executors of his estate, and form a valuable addition to the collection of the Branch.

ADMINSTRATIVE.

Tobacco Pest Suppression Act, 1933.—Under Part I. of the Act, Inspectors found the tobacco beetle (*Lasioderma serricorne*, F.) in one farm premises and four central warehouses. In no case was the infestation severe, but one central warehouse where tobacco was being matured, was fumigated by the owners. Evidence of the presence of the stored tobacco worm (*Ephestia elutella*, Hubn.) was found in two central warehouses operated by the same company. It was confined to waste tobacco. The owners' licences were suspended until all waste was swept up and burned, and the premises thoroughly cleaned.

Under Part II. of the Act, the tobacco whitefly (*Bemisia rhodesiaensis*, Corb.) was found on nine farms, on five of which leaf curl also was observed. Leaf curl was found on a total of six farms. In no case was whitefly or leaf curl abundant. When tobacco re-growth was in evidence, immediate steps were taken to have it destroyed.

Number of Licences Issued and Inspections made.

	1937.	1936.
Licences	583	595
Inspections	350	624

An interval of nearly four months occurred during which no inspections were made. This was necessitated by the resignation of the whole-time inspector and the consequent appointment and training of a new one. The time lost is reflected in the number of inspections carried out.

Importation of Plants Regulation Ordinance, 1904.

Number of Consignments of Plants, Fruit, etc., dealt with at Ports of Entry.

	1937.	1936.
Salisbury	2,834	2,343
Bulawayo...	11,221	12,159
Umtali	1,153	837
Gwelo	1,027	1,062
Plumtree	351	626
Beitbridge	—	40
	16,586	17,077

Number of Permits for the Introduction of Plants into the Colony.

	1937.	1936.
Special Permits	252	214
Annual Permits	62	60

Regulations in other Countries affecting Export of Plants from Southern Rhodesia.

Number of Certificates of Cleanliness issued in respect of Plants, etc., for Export.

	1937.	1936.
Certificates	48	56

More certificates were issued in respect of potatoes destined for neighbouring countries than for any other class of plant.

Six meetings of the Plant Regulatory Board were held during the year.

Injurious Substances and Animals Ordinance, 1909.

Number of Permits issued for the Importation of Bees, Beeswax and Foundation Comb from Overseas.

	1937.	1936.
Bees	—	—
Foundation Comb	—	—
Beeswax	3	3

The above permits are in respect of importations from overseas only. Importations from the Union of South Africa are unrestricted, and no records of such are kept by this Department.

Nurseries Ordinance, 1909: as Amended.

Number of Nurseries Registered and Inspected.

	1937.	1936.
Registered	13	16
Inspected	10	12

GENERAL.

Farms Visited.—Thirty-three farms were visited and advice given on pest control, besides the three hundred and fifty inspections made under the "Tobacco Pest Suppression Act, 1933.

Lectures and Exhibits.—A comprehensive exhibit containing some new features designed to promote the interest of visitors, was placed on the Agricultural Show at Salisbury, and a talk on insects was given to scholars.

Four lectures on ticks were given to the recruits of the British South Africa Police, and addresses were delivered to two District Farmers' Associations.

Two radio broadcasts from Salisbury were given by members of my staff, the one by Mr. Chorley entitled "The Influence of Tsetse Fly on the History of Southern Rhodesia" in April, and the other by Mr. Mossop, entitled "Some Tobacco Pests that can be Serious" in July, the latter being published in the *Rhodesia Agricultural Journal* for August, 1937.

Visitors.—In the course of the year Professor Parrot, of the Agricultural Experiment Station, Geneva, U.S.A.; Professor Munro, of the Imperial College of Science, London; and Dr. Compere, of the California Citrus Experiment Station, visited the laboratories and discussed some problems of insect control. Sir William Clark, High Commissioner for South Africa, accompanied by His Excellency the Governor, visited the Tsetse Fly Research Laboratory.

PUBLICATIONS.

The following papers by members of the staff were published during 1937:—

1. "Ticks infesting Domestic Animals in Southern Rhodesia" (continued), by R. W. Jack, *Rhodesia Agricultural Journal,* XXXIV., i., pp. 25-27. Salisbury, January. (Illustrated.) Revision. Reprinted as Bull. 1011.
2. "Water and Fat Content of Tsetse Flies," *Nature,* Vol. 139, No. 3505, p. 31 (Jan. 2nd). London.
3. "Some Facts and Common Fancies Concerning Declared Tobacco Pests," by M. C. Mossop, *Rhodesia Agricultural Journal,* XXXIV., 2, pp. 127-136. Salisbury, February. (Illustrated.) Reprinted as Bull. 1014.
4. "A Poison Bait for Young Locust Hoppers," by the Entomological Branch, Ibid, 2, pp. 137-141. Salisbury, February.
5. "Some Tobacco Pests that can be Serious," by M. C. Mossop, Ibid, 8, pp. 606-611. Salisbury, August. Reprinted as Bull. 1039.
6. "On the Biology of some Rhodesian Diptera, together with Descriptions of three Species of Asilidae new to Science," by E. G. Engel and Alexander Cuthbertson. Transactions of the Rhodesia Scientific Association, XXXV., 1, pp. 1-15. Salisbury, August. (Illustrated.)
7. "Biological Notes on some Diptera in Southern Rhodesia," by Alexander Cuthbertson, Ibid, pp. 16-34. Salisbury, August.

8. "The War Against Pests," by M. C. Mossop, *The Rhodesia Herald*, Salisbury, 19th August.

9. "The Effect of Temperature on the Reaction of *Glossina morsitans*, Westw. to Light. A Preliminary Note," by R. W. Jack and W. L. Williams, *Bulletin of Entomological Research*, 28, 3, pp. 499-503. London, October. (Illustrated.)

10. "An Unusual Winter Outbreak of Maize Weevil (*Calandra oryzae*, L.), by M. C. Mossop, *Rhodesia Agricultural Journal*, XXXIV., 12, pp. 935-941. Salisbury, December. Reprinted as Bull. 1050.

11. "Monthly Reports on the Locust Position," by R. W. Jack, Ibid, Nos. 1-12. Salisbury, January-December.

Acknowledgements.—I have pleasure in acknowleding the cordial co-operation of officers of other Departments and Divisions of the Agricultural Department throughout the year. In this connection may be mentioned particularly the Department of Native Affairs and B.S.A. Police in reference to locust administration, and the former again in connection with tsetse fly operations. Officers of the Division of Chemistry have been particularly helpful in connection with tsetse fly research.

I have also pleasure in testifying to the loyal service rendered by members of my staff during the year.

I greatly regret to record the death in May of the year under review of Mr. J. K. Kieser, who entered the Service of the Division in the capacity of Tsetse Fly Ranger, October, 1928. His death followed an operation for appendicitis.

Rhodesia Weather Bureau.

JUNE, 1938.

Pressure.—Barometric pressure was slightly in excess of normal.

Temperature.—Maximum temperatures were mostly a degree or two below normal, but minimum temperatures were above normal by a greater amount, and mean temperatures averaged about half a degree above normal.

Rainfall.—The usual guti weather was experienced over the Eastern Border, and some rather unseasonable showers occurred elsewhere.

PRECIPITATION.

Station.	Inches.	Normal.	No. of Days.
Beitbridge	Nil	0.02	—
Bindura	0.06	0.06	1
Bulawayo	Nil	0.03	—
Chipinga	0.59	0.66	6
Enkeldoorn	0.05	0.07	1
Fort Victoria	0.20	0.09	4
Gwaai Siding	Nil	0.00	—
Gwanda	Nil	0.06	—
Gwelo	0.03	0.02	1
Hartley	0.27	0.01	2
Inyanga	Nil	0.12	—
Marandellas	Nil	0.09	—
Miami	0.48	0.12	3
Mount Darwin	Nil	0.04	—
Mount Nuza...	1.78	2.48	13
Mtoko	0.02	0.06	1
New Year's Gift	0.28	0.41	5
Nuanetsi	0.04	0.08	1
Plumtree	Nil	0.00	—
Que Que...	0.06	0.01	—

Station.	Inches.	Normal.	No. of Days.
Rusape	0.09	0.29	3
Salisbury	0.12	0.06	1
Shabani	0.22	0.16	2
Sinoia	0.41	0.02	4
Sipolilo	0.01	0.04	1
Stapleford	1.48	1.21	9
Umtali	0.28	0.26	6
Victoria Falls	0.02	0.01	1
Wankie	0.09	0.00	1
Abercorn	Nil	—	—
Broken Hill...	Nil	—	—
Fort Jameson	Nil	—	—
Fort Roseberry	Nil	—	—
Isoka...	0.02	—	1
Kanchindu...	Nil	—	—
Kapiri Mposhi	Nil	—	—
Kasama	Nil	—	—
Kasempa	Nil	—	—
Livingstone	Nil	—	—
Lundazi	Nil	—	—
Mankoya	Nil	—	—
Mazabuka...	0.01	—	1
Mongu	Nil	—	—
Mpika...	Nil	—	—
Mufilira	Nil	—	—
Ndola	Nil	—	—
Petauke	Nil	—	—
Senanga	Nil	—	—

JUNE, 1938

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	8-30 a.m. Wet Bulb.	8-30 a.m. Dew Point	8-30 a.m. Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Beitbridge...	1,500	58.3	53.1	49	5.0	75.4	47.4	61.4	84	19	36	22	...	...	...	1	61.2	972.5	887.3	...	3.0	...
Bindura...	3,700	57.7	51.7	47	5.6	72.5	47.2	59.9	82	20	40	30	...	...	...	...	...	896.2	885.7	...	1.9	...
Bulawayo	4,393	54.6	48.3	42	5.5	66.8	46.1	56.4	78	19	36	21	...	24	...	2	55.6	875.1	886.9	873.8	3.7	8.2
Chipinga	3,685	57.8	53.1	49	4.4	66.4	50.3	58.3	78	19	44	22	...	23	...	...	57.6	898.6	887.7	...	5.4	...
Enkeldoorn	4,788	54.7	49.3	44	4.9	66.1	45.8	55.9	76	20	38	21	...	18	...	1	55.9	861.6	885.8	...	4.3	...
Fort Victoria... ...	3,571	55.2	50.3	45	4.4	68.1	44.6	56.3	81	19	38	var.	...	16	...	6	56.5	901.8	887.2	900.5	4.3	...
Gwaai Siding... ...	3,278	53.2	47.6	42	4.8	76.3	41.3	58.2	85	18	30	21	...	...	...	15	...	910.6	886.2	...	2.9	...
Gwanda...	3,233	56.2	50.1	44	5.5	69.5	45.7	57.6	83	19	34	22	...	16	...	2	58.1	913.0	887.3	...	2.8	...
Gwelo	4,629	53.4	48.2	43	4.5	65.9	46.4	56.1	77	19	37	11	...	26	...	2	55.9	867.5	886.7	...	4.3	...
Hartley...	3,879	56.9	50.4	44	6.0	71.5	45.6	58.6	78	19	39	12	...	8	...	2	58.9	890.9	886.3	...	3.4	...
Inyanga...	5,503	55.9	49.2	43	6.0	64.7	44.7	54.7	74	20	38	var.	...	27	...	6	53.9	...	...	...	4.4	...
Marandellas	5,453	52.6	47.6	42	4.3	63.8	45.1	54.4	75	20	37	2	...	27	...	2	52.9	...	...	...	4.8	...
Miami	4,090	58.7	52.5	47	6.0	70.6	45.7	58.1	78	20	41	22	...	9	...	...	56.8	883.4	885.5	881.8	2.6	...
Mt. Darwin	3,179	60.0	54.2	50	5.6	73.4	45.8	59.6	84	20	39	23	..	2	...	2	59.7	...	...	...	2.9	...
Mount Nuza	6,668	45.8	43.6	41	1.7	52.6	42.0	47.3	68	20	38	23	...	30	...	3	46.6	804.8	886.5	804.6	6.9	...
Mtoko	4,141	58.3	51.8	47	6.1	67.6	48.8	58.2	76	20	44	23	...	25	...	...	58.5	882.8	886.5	881.5	3.1	..
New Year's Gift...	2,690	58.1	53.3	49	4.5	71.7	49.7	60.7	81	19	41	23	...	8	...	...	...	...	...	...	...	6.1
Nuanetsi	1,581	59.2	53.4	48	5.5	75.7	44.7	60.5	88	19	33	22	1	1	...	7	...	970.5	887.6	...	3.4	...

JUNE, 1938 (continued)

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	Wet Bulb.	Dew Point	Vapour Press. Deficit	Maximum	Minimum	Max. + Min. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days: Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Plumtree	4,549	55.2	48.0	40	6.2	66.9	47.4	57.1	76	19	37	21	...	24	...	1	56.9	...	...	...	2.3	...
Que Que	3,999	56.2	50.2	44	5.4	70.9	47.3	59.1	78	19	39	22	...	11	...	1	58.7	887.4	886.6	886.1	4.5	...
Rusape	4,648	53.5	49.4	45	3.6	65.3	44.6	54.9	79	20	34	23	...	25	..	6	54.3	..	...	...	5.8	...
Salisbury	4,831	55.9	49.5	43	5.7	68.2	44.7	56.5	77	20	39	22	...	23	...	1	56.0	860.9	886.1	859.8	4.6	6.9
Shabani	3,131	58.3	51.7	46	6.2	69.2	48.6	58.9	84	19	36	22	...	14	...	1	58.9	...	...	...	3.5	...
Sinoia	3,795	57.3	51.7	47	5.1	73.0	43.8	58.4	80	19	36	30	...	2	...	6	57.9	...	...	...	2.7	...
Sipolilo	3,876	60.0	52.6	46	7.1	70.6	46.5	58.5	78	20	41	1	...	11	...	...	...	...	...	...	1.8	...
Stapleford	5,304	49.3	47.4	45	1.5	58.6	40.3	49.5	72	20	28	23	...	29	...	12	49.9	...	...	...	6.0	...
Umtali	3,672	57.3	53.1	49	4.0	69.6	49.0	59.3	80	20	42	23	...	15	...	...	57.1	898.9	887.7	897.5	5.1	...
Victoria Falls... ...	3,009	58.8	51.0	44	7.2	77.6	46.9	62.2	89	19	33	22	1	1	...	1	60.6	917.9	885.8	...	2.5	...
Wankie...	2,567	59.9	52.1	45	7.4	78.3	55.8	66.5	88	19	46	22	1	1	...	...	66.7	933.6	886.0	...	2.3	...
Abercorn	5,407	59.6	55.4	52	4.1	74.0	52.1	63.0	80	19	50	var.	...	1	...	...	...	840.1	883.6	...	1.3	...
Broken Hill	3,920	56.6	51.0	46	5.1	72.5	48.5	60.5	83	20	43	22	...	5	...	...	...	888.4	884.6	...	3.9	9.0
Chipili	3,900	57.3	53.5	51	3.6	79.5	47.7	64.2	86	19	42	18	1	...	...	...	...	...	...	...	...	...
Fort Jameson ...	3,620	62.3	56.5	52	5.9	77.9	54.1	66.0	85	19	50	1	...	...	...	...	...	892.1	885.6	...	1.3	...
Kasama...	4,700	60.3	54.9	51	5.3	75.5	50.9	63.2	82	21	46	25	...	...	...	...	...	867.3	884.2	...	...	...
Kasempa	4,500	55.0	50.4	46	4.1	73.1	43.2	58.1	77	9	35	22	...	2	...	7	...	...	...	...	...	...
Livingstone	3,140	55.1	49.1	43	5.4	76.6	47.0	61.8	86	19	37	22	1	1	...	1	...	912.7	885.5	...	3.1	...
Mazabuka Res. ...	3,385	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8.2
Mongu	3,475	58.7	52.0	46	6.4	80.5	51.0	65.8	85	19	39	22	...	...	...	1	...	901.7	884.0	...	1.4	...
Mpika	4,625	57.8	53.1	49	4.5	70.7	49.5	60.1	81	20	46	24	...	15	...	...	...	865.8	884.8	...	3.5	...
Mwinilunga	4,450	55.2	51.6	49	3.3	76.7	43.5	60.1	81	20	39	19	...	...	...	2	...	...	...	...	...	...
Ndola	4,140	56.5	51.6	47	4.5	75.0	46.5	60.7	81	20	39	19	...	...	...	1	...	879.3	884.3	...	1.4	...

Southern Rhodesia Veterinary Report.

MAY, 1938.

DISEASES.

African Coast Fever diagnosed on the farm Clifton, Melsetter Native District.

TUBERCULIN TEST.

A herd of 283 head of cattle on Leachdale farm, Insiza District, were inoculated. Four animals reacted to the test.

Twenty-three bulls, 28 cows and 24 heifers were tested upon importation with negative results.

MALLEIN TEST.

Forty-two horses and 14 mules were tested upon entry. No reactions.

IMPORTATIONS.

From Union of South Africa: Bulls 16, cows 36, horses 42, mules 14, sheep 45, pigs 1.

From Bechuanaland Protectorate: Sheep 1,319.

EXPORTATIONS.

To Union of South Africa: Oxen 11.

To Northern Rhodesia: Bulls 8, cows 21, sheep 84.

To Portuguese East Africa: Cows 55, oxen 133.

To Bechuanaland Protectorate: Pigs 12.

To Congo Belge: Bulls 1, cows 11.

EXPORTATIONS—MISCELLANEOUS.

To United Kindgom: Chilled beef quarters, 9,341; frozen boned beef quarters, 2,163; frozen beef sides, 67; kidneys, 17 lbs.; tongues, 181 lbs.; livers, 358 lbs.; hearts, 101 lbs.; tails, 92 lbs.; skirts, 36 lbs.; shanks, 80 lbs.

To Northern Rhodesia (in cold storage): Beef carcases, 195½.

To Congo Belge (in cold storage): Beef carcases, 77¾; mutton carcases, 8.

Meat Products.—From Liebig's Factory.

To Union of South Africa: Corned beef, 108,396 lbs.; beef powder, 48,000 lbs.; tongues, 3,600 lbs.

To United Kingdom: Meat extract, 23,619 lbs.; beef powder, 23,416½ lbs.

G. C. HOOPER SHARPE,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-38.

Monthly Report No. 67. June, 1938.

Reports of the Red Locust (*Nomadacris septemfasciata* Servi) have been relatively infrequent during June, probably due to cold weather preventing activity.

Winged swarms described as from "small" to "large" have been reported in the districts of Mazoe, Salisbury, Chilimanzi, and Melsetter only. The direction of flight varied from east to south, the general trend being thus south-easterly.

Some damage to winter wheat has been reported.

RUPERT W. JACK,
Chief Entomologist.

NOTICE

The Agricultural Journal of S. Rhodesia

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THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.
(Assisted by the Staff of the Agricultural Department).

PUBLISHED MONTHLY.

Subscription: 5/- per annum; payable to the Accountant, Department of Agriculture, Salisbury.

VOL. XXXV.] SEPTEMBER, 1938. [No. 9.

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Trout Fishing.—The waters of the Inyangombie River system on the Rhodes Inyanga Estate will be opened for Rainbow Trout fishing from the 1st October, 1938, to 10th April, 1939.

The cost of permits, which are obtainable from the Manager of the Estate, P./Bag Rusapi, or from the Office of the Conservator of Forests, P.O. Box 387, Salisbury, will be 3s. 6d. per day, 7s. 6d. per week, or £1 1s. per season.

Applications for more than one permit should give the initials of each person for whom a permit is required.

Rules governing the fishing in the above waters are obtainable on application from the Secretary, Department of Agriculture and Lands, or from the Manager of the Estate.

Chicken Pox Vaccine.—An article on chicken pox appeared in the February *Journal* of this year. This gave full instructions for the use of vaccine which is obtainable from the Director of Veterinary Research, Salisbury. Up to the present the cost has been six shillings per 100 doses, but the Government has now given authority for the price to be reduced to 4s. 6d. per 100 doses.

Cleanliness Aids Insect Control.—Tobacco growers and graders are advised that as a preventative measure against pests of stored tobacco, all waste tobacco should be destroyed or otherwise suitably disposed of immediately, and premises thoroughly cleaned or re-cleaned.

The retention of tobacco on the farm between the present time and the coming season is inadvisable.

The Farming and Mining Population.—According to the latest Bulletin issued by the Government Statistician nearly three-quarters of the total number of Europeans engaged in agriculture were in *Mashonaland,* the actual number being 3,016 out of a total of 4,091 (exclusive of five travellers). Of the former figure about one-fifth (actually 627) are in the Salisbury district. There were also 395 persons in Mazoe; 350 in Lomagundi; 232 in Melsetter; 229 in Makoni; 191 in Marandellas; and 179 in Charter, all districts which are primarily agricultural. In Hartley and Umtali, where the mining industry is also of importance, there were respectively 201 and 175 persons engaged in agriculture.

Slightly more than one quarter of the persons engaged in agriculture occurred in *Matabeleland* (1,075 persons). Gwelo, where mining is of greater importance than agriculture, was nevertheless the most important agricultural district in Matabeleland, there being 289 persons in the industry as compared with 206 in Bulawayo, 111 in Insiza and 102 in Bulalima-Mangwe, where agriculture is the dominant industry.

Out of a total of 3,699 Europeans employed in the mining industry three out of every five persons were in Matabeleland, where there were 2,253 Europeans engaged in this industry as compared with 1,446, or 39 per cent., in Mashonaland.

The most important mining as well as agricultural district in *Matabeleland* was Gwelo, where 562 persons occurred in the industrial group. Next in importance came Bulawayo with 337 persons, Belingwe with 295, Selukwe with 287, Bubi with 247, Gwanda with 171, Insiza with 124, and Wankie with 117. In all the above mentioned districts, with the exception of Bulawayo and Insiza, mining was the only industry of any importance.

In *Mashonaland*, Hartley was by far the most important mining district, there being 509 persons in this industry as compared with 292 in Mazoe, 177 in Salisbury, 160 in Umtali and 109 in Lomagundi. In each of the four latter districts, however, agriculture was the principal industry.

Butter Production.—Purchases of butter-fat by creameries decreased from 53,591 lbs. in May to 45,045 lbs. in June, and the amount of butter manufactured from 63,759 lbs. to 54,079 lbs. Imports rose to 164,150 lbs., while exports amounted to 8,575 lbs.

In the first half of this year purchases of butter-fat by creameries, 533,867 lbs., were 179,032 lbs. lower than in the corresponding period of last year, and butter production amounted in 1938 to 643,506 lbs., or 202,725 lbs. less than than in the first six months of 1937. With the large quantity of butter imported in June, total imports in the first half of this year amounted to 186,380 lbs. There were 128,243 lbs. exported.

Prices paid for butter-fat remained at the same level as in the previous month—1s. 3d. for 1st, 1s. 1d. for 2nd and 11d. for 3rd grade. Wholesale butter prices were also unchanged at 1s. 7d., 1s. 5d. and 1s. 3d. respectively for 1st, 2nd and 3rd grade.

Cheese.—The amount of cheese manufactured also decreased, from 30,807 lbs. in May to 24,229 lbs. in June. Imports amounted to 4,287 lbs. and exports to 6,177 lbs.

Cheese production in the first half of this year totalled 226,187 lbs., about 14,300 lbs. more than in the corresponding period of 1937. There were 35,126 lbs. of cheese imported and 36,181 lbs. exported during January-June of the current year.

The late
Major G. C. Hooper Sharpe, M.R.C.V.S., M.C.

It is with the deepest regret that we have to record the death of Major G. C. Hooper Sharpe, M.R.C.V.S., M.C., Chief Veterinary Surgeon of the Colony of Southern Rhodesia.

Mr. Hooper Sharpe was admitted into hospital in July suffering from an attack of double pneumonia. He was, how-

ever, discharged after two weeks' detention and was convalescing at his home "Dunothail," Highlands, and seemed to be progressing favourably. It therefore came as a shock to all those who held him in high esteem to hear of his sudden death, due to heart failure, on 27th August. Thus passed a valued civil servant who was noted for his energy and capabilities and who had great professional and administrative experience and ability.

Granville Cecil Hooper Sharpe was born on 2nd June, 1880, and was thus in his 59th year at the time of his death.

He studied at London University and qualified for his M.R.C.V.S. on 20th July, 1906.

In 1907 he came to Southern Rhodesia, and was appointed a Government Veterinary Surgeon at Bulawayo on 22nd June of that year, and for the next eight years he served in Matabeleland.

In September, 1915, he joined the Southern Rhodesian Column and proceeded to German East Africa, where he served with distinction as Veterinary Officer, concerning himself mainly with the control of Rinderpest in the area of operations. It was whilst engaged upon this duty that Major Hooper Sharpe was awarded the Military Cross for repelling attacks of enemy patrols.

In 1917, a few months after his return from German East Africa, at the conclusion of operations, he was transferred on temporary duty in connection with African Coast Fever to the Victoria district, being appointed as District Veterinary Surgeon of this area two years later.

In 1921 he acted temporarily as Acting Assistant Chief Veterinary Surgeon in Bulawayo during the absence on leave of Mr. C. R. Edmonds. In 1924 he returned to Bulawayo, on the retirement of the Assistant Chief Veterinary Surgeon, Mr. Edmonds, and was appointed as Senior District Veterinary Surgeon of Matabeleland. On two occasions, while he held this appointment, he acted as Chief Veterinary Surgeon during the absence of Mr. J. M. Sinclair in 1924 and 1929.

In 1933 he was transferred to Salisbury as Acting Chief Veterinary Surgeon, and on 27th February, 1934, he was appointed Chief Veterinary Surgeon. Major Hooper Sharpe was also Chief Veterinary Officer of the British South Africa Police.

Major Hooper Sharpe leaves a widow and two sons, to whom the deepest sympathy is extended.

Report on Trout Streams.

By C. Sutton, Inland Fisheries Officer, Natal.

In accordance with a request from the Secretary of Agriculture of Southern Rhodesia for a general report on the trout localities, I have visited these and have pleasure in submitting the following report in which I have endeavoured to apply to conditions obtaining in Southern Rhodesia, the results of observations made over several years in other trout area, and to impart as much useful information as possible, and I have included recommendations for future action and control. I was enabled to inspect all areas where trout are already plentiful, and also all potential trout streams.

Habitat.—The trout, both the Brown Trout (*Salmo fario*) and the Rainbow Trout (*Salmo Irideus*), require cold clear water in which to live, and as the Equator is approached, the greater must be the altitude of the water which it is proposed to stock in order that the temperature may remain low enough. In the Cape Province of the Union of South Africa trout will live at sea level; in Natal they do not survive below 4,000 feet, whereas in Kenya Colony they will live between 6,000 and 7,000 feet, but will only breed above 7,000 feet, as is shown by the following quotation from "Inland Waters of Africa," by S. and E. B. Worthington:—

"In selecting waters for trout introductions in country lying on the Equator, the first consideration is that of temperature, for trout cannot breed in any water warmer than 58 degrees F. on account of the fact that their eggs become addled and cannot develop. In Kenya this necessarily limits trout waters to over the 7,000 feet contour, although in places the fish can descend into lower altitudes for growth in between breeding periods. . . ."

In Southern Rhodesia enough rivers have not yet been stocked to give sufficient evidence from which the altitude

below which it will be useless to stock can be deduced. It would appear to be somewhere between 4,000 and 5,000 feet, but the nature of the source of the water would also be a deciding factor, as a river with its source in some mountain area would have a lower temperature than one with its source at a lower altitude. It would appear, therefore, that only streams which have their sources in one of the big mountain masses at Inyanga, Stapleford and Melsetter are worth stocking at first; experiments can be carried out later in other rivers.

Stocking.—Stocking of rivers can be carried out in two ways:—

(*a*) By the hatching of ova purchased from a hatchery, and

(*b*) By the capture and transportation of small fish from some water already well stocked.

Method (*a*) can be sub-divided into (i.) Release of alevins, *i.e.*, the planting out of the young fish as soon as they have absorbed the yolk sac and are ready to feed. (This is the quickest and cheapest method.) (ii.) Transferring the alevins from the hatching boxes to ponds where they are fed on the yolk of eggs and minced liver for a period of from three weeks to three months when they are released in the river.

Method (*b*) is carried out by capturing small fish in a well stocked water by means of angling for them with a fly in the usual manner. All helpers must be warned to handle the fish with wet hands and not to squeeze them, as this is liable to injure them. As the fish are caught, they are carried in buckets to a 20 gallon perforated zinc container which is stood in the stream in still, or very gently flowing water. When enough fish have been caught, this inner container is lifted out and put into an outer container previously filled with fresh river water. As long as fresh water is added every ten miles or so, trout can be transported long distances.

As the fish released must rely on the natural food in the river, competition must be avoided by putting only a few into each suitable pool; twenty to thirty alevins which must

be put in shallow fast running water 2 ft.—5 ft. deep as similar to natural spawning beds as possible; and six to eight fingerlings, which prefer deeper water.

Success in stocking a river is usually more easily obtained by planting the trout in the head waters of the river. Numerous failures can be attributed to attempts to stock being made too low down the river.

As the alevins are very easily transported by car I recommend that all ova be hatched at two Government stations, the first at the Inyanga Rhodes Estate, where all trout intended for stocking the Inyangombi, Pungwe and Odzi Rivers be hatched; and the second at the Stapleford Forestry Station where the trout for the Odzani River and other streams in the Melsetter district be hatched. I do not recommend any attempt being made to produce trout ova locally on account of the expense involved, and the uncertainty of securing good results in this highly specialised undertaking.

Which Species—Brown or Rainbow?—In some rivers a mixed population of both species will maintain itself, whereas in others, either one or other eventually disappears. The Bureau of Fisheries of the United States of America states that the Rainbow should not be used to stock small and shallow streams, but deep, fast-flowing rivers should be selected. The Brown will stay in small and shallow streams and provide quite good sport. The Bureau also states that experience in the United States shows that the Brown will stand heavier fishing and will produce bigger fish under heavy fishing conditions. From what I saw of the Pungwe River system, I think that Browns would do better than Rainbows, and this also applies to the Nyahodi and Silver Streams near Melsetter.

Natural Reproduction.—In all the rivers examined, abundant gravel beds suitable for spawning were seen. In each river system assurances were given me that the trout had reproduced under natural conditions in the rivers.

Two fish were killed at Inyanga, the first a cock fish which was just approaching the end of its second year, but the milt sacs were swollen and it would have bred this winter, although, normally, the trout does not spawn until its third winter.

This precocity is common where conditions are good. The second, a hen fish, contained ovaries with eggs the size of No. 4 shot which would have been deposited probably in six to eight weeks time when the ova had reached the size of a dried pea.

Reports of spawning from June to November were received, and it would be interesting to know if these reports are correct. The signs of a spawning fish are: the anus becomes red and enlarged, black blotches appear on the sides and the flesh is soft and unfit for eating, and in the female, the abdomen is swollen. After the fish is spent these conditions persist for some time.

Unless the milt or ova comes away with no pressure on the body of the fish, it cannot be said to be ready to spawn. And even if it does come away readily, the ova may have been held over after the proper spawning time for some reason such as lack of spawning beds, lack of mats, or too low water.

Where the winter period is not very well defined, spawning may persist over a much longer period, but reports of a few odd early, or late, spawners should not influence the determining of the date of the open season, which should give the maximum protection to the greatest number of spawners.

Food Supply.—Examination of the river bottom in each instance showed that the quantity and variety of aquatic insects which the trout use for food were excellent, midge larvae particularly being very abundant, which augurs well for the fish, as this insect is one of the main sources of fish life.

Other aquatic insects seen in quantities in the streams were dragon fly larvae, and larvae of the caddis fly, the stone fly and the May fly. Trout do not feed on vegetation in any form, but take only frogs, insects, minnows, etc., and insects are taken in all stages of their life cycle from larvae to the spent imago floating down the stream; frogs and tadpoles are readily eaten, and these seem to be still numerous on the rivers. These and crabs constitute the food which produces the big trout. Unfortunately the only minnow is a small high-veld barbel, and this form of food will be quickly exterminated by the trout.

Land insects which fall into the water from over-hanging vegetation, or are blown in, are readily eaten; in the stomach of one trout at Inyanga two bees were found. Large quantities of food are also washed in during rains.

Age.—A means of determining the well-being, or otherwise, of a trout is by working out a "condition factor" for that particular fish, and then comparing its condition factor with the average condition factor which has been previously found for that river. The condition factor is found by using the formula: Weight=(length in inches) cubed x C.F.)

$$\frac{\text{(length in inches) cubed x C.F.)}}{100}$$

The condition factors for the trout caught both at Inyanga and in the Odzani have been worked out and show very high condition; the average at Inyanga for the first half of the season was approximately 56; for the latter half it had dropped to 45.

If the age of the fish is known and the condition factor is worked out, a true idea of the state of the fish population can be arrived at. The age of a trout can be determined by an examination of its scales through a miscroscope.

The two fish killed at Inyanga had the following records:

Length.	Weight.	C.F.	Age.
$9\frac{1}{4}$ in.	6 oz.	48	1 plus (approaching 2nd winter)
$10\frac{1}{4}$ in.	8 oz.	47	2 plus

The first was a cock fish which would have spawned this winter, and the second was a hen fish, the ova being the size of No. 4 shot.

The condition factor of these fish is good and the growth for age is particularly good. This is a usual condition in all virgin rivers, and it will be found that the average rate of growth, and average weight, will decrease as the numbers of fish in the rivers increase.

Vegetation.—The vegetation growing near a river can frequently be used as an indicator as to whether trout will survive or not. At Inyanga I was pleased to recognise an old

friend which natives call the "Mtshitshi" in Natal (*Leucosidea serica*). Observations of the plant life on known good trout streams can be used as a further guide to the selection of suitable water to stock.

The type of stream inspected by me in the trout area was all of the fast flowing rocky bottomed type which does not support aquatic vegetation, but in isolated pools aquatic plants were observed, and quantities of insect life were present.

Marginal plants (mostly consisting of reeds) were frequently seen, and these form a valuable breeding ground for certain insects.

The banks of all the streams were very overgrown with various types of vegetation, so much so that many good pools were unfishable and the most economic use of the water was not being made, that is, from the angler's point of view.

As the overhanging vegetation is a valuable source of food supply, and gives shade and protection to the fish from birds, I want to emphasise that cutting back of the growth should only be done where it is necessary, and then only sufficiently to enable the angler to place his fly all over the pool.

Stream Improvement.—It has been suggested that the construction of a series of weirs should be undertaken to improve the fishing in the rivers, but these are not recommended for the following reasons:—

1. Water-tight weirs tend to silt up and produce a shallow, featureless pool which will not hold fish.

2. They offer big resistance to floods and are liable to be swept away.

3. It would be necessary to construct fish passes, otherwise the normal movements of the fish would be interrupted.

4. It is too early to begin stream improvement as all good lies are not yet occupied by fish, which will be the case only when the stream is fully stocked.

5. The expense would not justify the results.

MANAGEMENT.

Production of Big Fish.—The history of most rivers stocked with trout has been the same; when angling started good bags of big fish were obtained. As the fish bred and the numbers increased, the average size decreased and a cry arose asking why the fishing had gone off.

In order to allow the first phase to persist as long as possible, I would like to warn the Administration against initial over-stocking and overprotection; these two together will decrease the average size quicker than anything.

Most anglers like to take big fish, and it should be the object of the Administration so to manage a portion of the river as to provide big fish only. As pointed out previously the average size decreases as the numbers increase, and therefore the object may be obtained by restricting the number of fish in the lower, deeper reaches. These reaches should, at first, be stocked lightly, and later not at all, because the fish will drift down as they grow bigger and require more room and more food. Close observation of the fish population by the officer in charge of a stream should be made and as soon as the numbers begin to increase, stocking of that particular stream should cease, and if the numbers continue to increase, the bag limit per day should be increased.

Denudation.—The denudation of the water shed should be guarded against as far as possible; with the removal of the vegetation will come heavier floods, lower water in the dry season, and warmer and dirtier water, all conditions which are not favourable to trout. Floods will scour out any weed beds and gravel bars and wash away any insect food contained therein.

When cutting of vegetation is undertaken, care should be used to avoid cutting enough to start erosion of the banks, for the foregoing reasons.

Demarcation of Trout Area.—The introduction of the American Black Bass has started in Southern Rhodesia, and as this fish can live in water too hot for trout, I suggest that the Government makes a survey of the possible trout rivers

and demarcates an area into which no Black Bass may be introduced, even in dams in that area, so that all water which would accommodate trout should receive them.

The reason for this exclusion is that Black Bass is a very predaceous fish and its natural food consists of any fish smaller than itself, and even if confined to dams, they are bound to escape sooner or later. One big bass will dominate a pool to the exclusion of any other fish, while not reproducing itself.

Predator Control.—The spoor of otter was observed in many places, and although they may not be numerous, they will tend to increase as the number of trout increase. That they eat trout is beyond doubt, but the fact that they subsist chiefly on crabs is the principal reason for keeping check on their numbers, the crab being the best food obtainable to grow out big fish.

Some giant kingfishers were seen, and these take their toll of the smaller fish, but as they are picturesque and their cheerful cackle is welcomed by nature lovers, I do not recommend their wholesale destruction.

The black birds variously known as "Snake Bird," "Diver" or more usually "Cormorant" has, on the other hand, nothing to recommend them, and they do immense destruction on any water and should be exterminated.

GOVERNMENT CONTROL.

The history of the introduction of trout into most British Colonies has followed very similar lines. First of all a small body of enthusiasts imports ova and succeeds in stocking a stream in their vicinity. From this nucleus other clubs and acclimitisation societies spring, and so trout fishing spreads through the Colony. Each club formulates its own rules, and after a time the demand for uniformity brings the demand for central control, and the Government is asked to take over. The Cape Province and Natal, in the Union of South Africa, and New Zealand and Australia have passed into Government control, and Kenya has just reached this stage. The time has come for the Government of Southern Rhodesia to take control for the following reasons:—

1. The public of the Colony now realise that they have an asset in their mountain streams, and realise also the benefits of a healthful holiday spent in the open air on those streams.

2. The lack of uniform control is hindering the progress of stocking the streams.

3. The Government can see that any work done is for the benefit of the Colony as a whole.

4. The limited supply of ova received from hatcheries would be used to the best advantage.

MEASURES OF CONTROL.

I suggest that:—

1. The Government, by the issue of regulations, should take control of trout introduction and fishing.

2. The Government purchase all necessary ova and hatch same at two stations to be established at Inyanga and Stapleford.

3. A Government officer should make a thorough survey of the streams suitable for trout and formulate a stocking programme to be completed as soon as may be.

It is essential that the permission to stock is first obtained from the riparian owners, and if an agreement can be reached concerning angling before the fish are established, numerous difficulties would be solved.

4. The streams so stocked to be closed to fishing until the Government officer in charge considers that the trout are well enough established to permit of an open season.

5. The formation of clubs locally should be encouraged and the members asked to assist the Government by carrying out stocking operations under the control of the Government officer, and by forwarding to him their recommendations, after due observance of local conditions, for the length of the open season; date on which it should commence; the number of fish to be killed in one day, or in the season; and the length under which a fish must be returned to the water.

6. The Government to appoint native water bailiffs who should be, preferably, special sworn-in constables with powers to arrest any native contravening the fishing laws. These water bailiffs could also keep a check on the number of anglers on the rivers by obtaining signatures. Another of their duties would be the control of otters, etc.

7. The regulation should contain:—

(a) A paragraph restricting angling for trout to rod, line, and non-spinning feathered fly only.

(b) All under-sized trout must be handled with wet hands and carefully returned, unharmed, to the water.

8. The licence fee of £1 1s. 0d. per season should be imposed, this licence to allow the holder to fish any open water in the Colony, subject to the permission of the riparian owner. This last clause should be clearly stated on the licence.

With reference to Paragraph 5 above I would like to thank those members of the Umtali Angling Club whom I met for their helpful information which they so readily supplied. This club was the pioneer of trout stocking in the Colony.

Throughout my tour of inspection I was accompanied by the Conservator of Forests for Southern Rhodesia, Mr. E. J. Kelly-Edwards, and I was able to demonstrate to him personally the type of water suitable for each species of trout; the type of stream bed suitable for planting alevins and fingerlings; where vegetation should be cut, and how much.

I cannot close this report without asking the Government to take more active part in the control of their indigenous fishing, particularly the tiger fish. Although they appear to be innumerable to-day, with unrestricted fishing, and dynamiting, their numbers will be quickly decimated, and what is undoubtedly a great asset will, in time, be lost to the Colony.

Uncontrolled Grass and Forest Fires and their Prevention.

By the Rev. Father A. B. BURBRIDGE, S.J.

Foreword.—With the approval of the Secretary for Native Affairs, arrangements have been made with the Department of Native Education for the holding of an essay competition in the MISSIONARY SCHOOL CIRCUITS of the Colony, and prizes in varying amounts will be awarded to the pupils in these schools for the best essay presented describing the evils arising from uncontrolled veld fires, and the reasons why every precaution should be taken to prevent their occurrence.

It is hoped that the following article which in the main has been prepared by the Rev. Father Burbridge, S.J., will prove useful and suggestive to teachers and will provide a framework around which they may build up the construction on the subject which they give to those attending their schools.

All those in Southern Rhodesia who are actively co-operating in the National movement for the prevention of uncontrolled veld fires will be deeply grateful to the Rev. Father Burbridge for the time which he has given to preparing these notes in a manner, which from his experience, he believes will make a special appeal to the native mind.

H. G. MUNDY, Secretary,
Department of Agriculture and Lands.

The aim of this article is to show that veld fires are a source of lasting harm to the country in which we live, and that he who aids and abets those people who are responsible for causing grass and forest fires is as much an enemy to the community as the soldier of a foreign army who comes to lay waste our land in time of war. Once this is understood it is seen that to put a stop to the uncontrolled burning of the veld is one of our most important duties. No claim to share in

this country's life is valid without recognition of the implied responsibility to preserve and improve the God-given bounty of its soil and no good Rhodesian, European or Native, can afford to shirk the duty of co-operating with the measures framed by Government for preserving the productive qualities of the land. So, now that the much-discussed bogey of transportation from their Fatherland has been finally laid by those who bear the sword in the name of our King, we may hope that natives will cease firing on shadows and exchange their needless fear of being moved out of Southern Rhodesia for the more rational fear of their lands in Southern Rhodesia being removed from them by soil erosion.

The demon of erosion is no imaginary evil. Those who have had their eyes opened by wise instructors see tokens of its ravages everywhere, and realise that these are due in great measure to veld-firing. But have they yet realised that, unless a halt is called to the destructive march of these fires, the native inheritance will become, within a measurable distance of time, a desert? We may sing to ours heart's content:—

"This is my own my native land,"

only if we remember that no man can do what he likes with his own to the detriment of the common good.

The Nature and Magnitude of the Evil.—The white man's news sheets are full of incidents relating to loss of life and property; now it is a native mauled by lion or leopard, or again a fatal accident to a native in collision with a motor car; and in the rainy season how often we read of natives struck by lightning or drowned in the waters of a flood; and we have all heard tell in our own homes of the shocking roasting of human beings and of the discovery of their charred remains on the scorched veld. Did we ever reflect that these remains were yet another burnt offering to ignorance or criminal negligence or the deliberate self-seeking of the game-hunt regardless of the harm that may come of it? Some of us remember how a young man, seeing his favourite dog trapped between two fires, rushed to its rescue and was thus himself trapped and devoured by the flames. Each new season's grass fire brings its tale of such incidents. But the full story of such tragic events cannot be compared with that of the damage done to the whole country by grass fires. The Great Fire of

London reduced the greater part of that city to ashes: but London was rebuilt. You cannot thus *rebuild the soil.*

Both life and property can be insured against fire; but you cannot insure the country against the damage done by grass fires. You see we are seeking to measure the magnitude of this evil by comparing it with other evils which, however great in themselves, admit of some remedy. Thus we may think of tribal raids accompanied by burning of unharvested crops, or of the Great War and its toll of death. But wars and raids burn themselves out. So do grass fires, it will be said. This is not so. The harm done is not a matter of mere combustion. The damage done to the soil does not end with the extinction of the flames. The loss of the grass burnt is insignificant compared with the havoc wrought on the soil by the cumulative and exhausting effects on its vegetable content.

The effect of the regular recurrence of these fires resembles the malady of a *ndonda,* the victim of chronic disease. What a pitiable plight is his, as he appears to recover for a day or two and then suffers relapse, gripped in lingering debility until this mysterious malady has sucked the marrow out of his bones and brought him to his grave. This *ndonda* is the living image of the effects of grass fires on the sources of life. There is no charm against soil erosion. No medicated smoke will meet the case. It is an evil which can only be put an end to by the total prevention of veld fires.

The *Mukondombera* (influenza) epidemic of 1918 brought death to the doors of every native village, but finally it passed away. The fatal effects of grass fires remain and each returning year they are intensified. Hookworm, bilharzia and epidemics of every kind entail incredible suffering, but they are evils which can be cured. There is no cure for this grass fire disease but the uprooting from ill-informed minds of the ideas that keep these fires alive.

Beasts of prey are known to select a special kraal to which they return again and again to carry off victims to their lair. These fierce visitors have designs on a single kraal; this grass fire evil strikes at the life of the entire community.

Swarms of locusts are voracious visitors and devour our crops; but even they can make a delicious relish, and after all they take wing and fly away; but the evil of these devouring flames resembles a swarm of locusts which destroy but do not provide food and which make our fields their homes.

Barrenness our fathers had a wholesome horror of. They knew that on fertility in man and beast and field the very existence of the community depended. In this their judgment was sound. To ward off sterility they examined the innermost secrets of nature and exploited all the worlds they knew of, visible and invisible. The measures taken were often childish and often based on ignorance, yet their zeal was not misplaced, even though their weapons might be blunted by ill-informed ideas. Hence their fear of ill-disposed persons believed to have the power to blast the crops and put a spell on productivity in every direction. Hence the abundant variety of magical expedients to ensure the fulfilment of nature's law; increase and multiply. But no person was ever supposed to put a curse on the entire community comparable with the blighting effects of veld fires. These fires eat up our water supplies and destroy the fertility of the soil silently and without ceasing. The rains of each wet season rapidly carry away to the rivers, and thence to the sea, from the burnt veld, the life-giving properties of the soil.

Witchcraft.—We are aware of the precautions taken by our elders in bygone days to rid the community of malignant persons believed to be capable of dealing out death by magical processes. These irrational measures were inspired by a good purpose. The terror with which the victims were regarded arose from the belief that these men were a menace to the life of the tribe. Therefore, in defence of the welfare of the community, the people rose up in anger and slew them as assailants of the common good.

Zeal for the public interest is always worthy of immitation. Refuse, therefore, to aid and abet fire makers who are responsible for far greater evils than those ever supposed to have been caused by any Murowi. How then can we express surprise when those found guilty of the crime of setting fire to the veld are brought to justice and severely punished?

We have reviewed various examples of the evils which may beset a people and yet be overcome. Compared, even when all are taken together, with the damage done by veld fires, they are but a speck in the balance. Lest this should be regarded as an over-statement of the facts, consider first the *mischief done in the past.* It is estimated that to reinstate the soil would cost millions of money; and the time required for this almost impossible task is beyond reckoning. To make a just estimate *of future damage* we must give heed to the words of the wise who know from observation of the facts. They assure us that, unless an end is made of this evil, beggary, famine and starvation will be the lot of the native people. No educated native can afford to say: "This will not come in my time," unless he wishes to fall out of step with other enlightened natives who are determined to secure better prospects for their children than those provided by the backwardness into which they themselves were born. Unless parents restrain their children from having part in this practice of firing the veld there is no future for them but the one stated above by those who have studied so anxiously this vital question. Their prophecy is supported by facts of scientific observation in this way: by the agency of veld fires they tell us:—

(*a*) The better and more leafy annual grasses are unable to re-establish themselves in bare and unsheltered soil.

(*b*) The cover of vegetable matter in process of conversion into humus is reduced to ash and is carried away by wind and storm water.

(*c*) The finer and more nutritious grasses are destroyed for they cannot resist being burnt each year by fire.

(*d*) The loss of moisture from the soil due to evaporation by sun and wind, during the early part of the rainy season is increased, there being no shelter and shade which the unburnt grass would otherwise have afforded.

(*e*) Grass fires are largely responsible for *soil erosion* by making easy the rapid flow of rain water over the burnt veld which carry away the loose surface soil into the "spruits" and rivers.

(*f*) Cattle are exposed to great suffering by being deprived of essential grazing, which, though admittedly during the winter months, very dry and deficient in feeding value, is still better than no grazing at all. How often do we see the veld burned off in the hope of early rain. No rain perhaps falls for weeks and, except in vleis, if the grass should spring a little it quickly withers away under the intense heat of the sun. The ground is left as bare of grass as when the fire first swept across it and the cattle in their poverty and weakness remain a pitiable sight.

(*g*) Trees of all ages and sizes are injured or destroyed and thus the supplies of timber so necessary for our daily use and comfort become less and less.

In the dry season the water in the rivers and pools is clear. After rains have fallen it is muddy or cloudy—the muddiness or cloudiness being caused by the surface soil or sand carried into the streams by the rain-water rushing over the exposed surface of the land.

Causes of Grass Fires.—Fires are caused by ignorance, negligence, mistaken beliefs and lack of a sense of national responsibility. The native who carried a firebrand and, by letting the live embers drop as he returned home, was responsible for a huge grass fire which cost him six months in jail. Such criminal negligence will continue so long as the criminal is convinced that he has done no wrong, and is even prepared to defend himself as a saviour of his country.

"A man convinced against his will,
Is of the same opinion still."

It is the belief in the minds of unenlightened Africans that huge grass fires are necessary to make rain and that a vast expanse of blackened veld below and clouds of dark smoke above are a proof that each has done his duty in contributing to the common good by making sure of plentiful rains.

Tradition thus plays its part. What has always been "our custom" must be in order, it is said. Then there is the lack of a sense of community welfare, private advantage prevails, and grass fired for game is the upshot, let the country suffer as it may.

Remedies.—Punishment can only deal with casual and local offences, it is powerless to cope with a disease of the mind which is universal. If all those guilty of causing veld fires were arrested, jails would be filled and still these fires would rage with unabated fury. Game-hunts and the coveted green grazing patch are minor mischiefs. The crying offence of old was the conspiracy of an entire community in spring-time to envelope the heavens in smoke. This effect was deliberately sought in all good faith on the false and traditional principle that things alike in colour, shape and texture beget their like. Thus black smoke clouds were believed to bring rain clouds. These old-fashioned ideas, already giving place to a more rational outlook, cannot be knocked out of well-intentioned heads merely by compulsion and fault finding. They will only be entirely removed when right ideas are imparted in their place by reasonable, patient and enlightened instruction. Chiefs and headmen, parents and children, teachers and pupils are willing nowadays to be taught, provided they can trust their teachers. The teacher who collects from his pals snake tail-ends to smoke in his pipe to ward off evil is a dull-witted fellow unworthy of his high vocation, and he is no less a nitwit than his pupil whose face glows with hope at the sight of smoke-darkened heavens. Teachers and pupils who have been really educated know that this smoke, so far from being a forerunner of rain, is but a device of fuddled brains and minds darkened by ignorance. There is no malice in all this mental fog but, forced into a new world, natives are opening their minds to new ideas, and hungering for instruction, provided it be patiently instilled. Old beliefs injurious to their fellowmen must give way to more enlightened ideas, and the misguided thought that grass fires promote rain or bring any other advantage to the community must be banished for all times from our minds; on the contrary, they reduce our cattle to the point of starvation and death; they eat up our water supplies and cause the fertile surface soil of our lands to be washed away to the sea.

Government Loans and Subsidies, etc.

FOR SOIL AND WATER CONSERVATION, GREEN MANURING AND ARTIFICIAL FERTILISERS.

It appears that large numbers of farmers are still unaware of the easy conditions under which loans and subsidies may be obtained and are also unaware of the conditions under which the Premier Portland Cement Company (Rhodesia) Ltd. provides supplies of cement at reduced rate for water conservation works.

It has been decided, therefore, as a result of the need for expansion of such works, stressed by the Soil Conservation Advisory Councils of Mashonaland and Matabeleland, to set out the general conditions briefly in bulletin form.

Irrigation Loans.—These loans are obtainable for any soil or water conservation works approved of by the Irrigation Department, such works including dams, weirs, canals, contour ridges and storm drains. Loans are also obtainable by Farmers' Associations or any other approved Committee or body of farmers, for the purchase of implements and plant for the construction of soil conservation works.

The application forms may be obtained either from the Director of Irrigation, P.O. Box 387, Salisbury, or from the Irrigation Engineer (Matabeleland), P.O. Box 566, Bulawayo.

Before applying for a loan it is very advisable that the scheme be first investigated by an Irrigation Engineer and farmers should apply for a visit to one of the two officials mentioned above. These visits are carried out free of charge if the time occupied by the Engineer on any one farm is not more than twenty-four hours, and if visits can be carried out during the course of a tour. Designs and estimates of costs are prepared by the Irrigation Department and the work itself pegged out, leaving the farmer in a sound position to proceed with the construction.

These loans are normally available under the following conditions:—

(*a*) Interest is charged at the rate of $4\frac{1}{2}\%$ per annum on the amount of the loan outstanding and, if desired, the interest charges over a period not exceeding the three initial years, may be funded with the loan, no repayment of capital being necessary during such period.

(*b*) Repayment of the loan and interest may be made in annual instalments over a period not exceeding 17 years, the first repayment being due not more than three years after the loan is obtained. Should a farmer be prepared to commence repayment within any period less than the first three years, the repayment period may be etxended up to a maximum of 20 years.

The actual period for repayment will depend on the amount of the loan and the purpose for which it is required.

(*c*) In the case of farms which are owned by the applicant, loans are secured by registration, in the office of the Registrar of Deeds, against the title deeds of the property concerned. Such registration is not published in the *Government Gazette*.

Alternatively, these loans may be secured on the personal security of two sureties who must be holders of immovable property in Southern Rhodesia, and such sureties are insisted on if the farm is heavily bonded to a private individual.

In the case of farms held under Agreement of Purchase from the Government, security is obtained by the applicant giving written agreement that title shall not be issued until the loan is repaid in full.

In the case of Crown land farms held under lease the cost of the work will be paid for out of Government funds, provided the leaseholder agrees to having his annual rental increased by 4% of the capital outlay involved. When the farm is alienated later under Agreement of Purchase terms

the works will be regarded as a permanent improvement and their cost, plus interest at 4% per annum, will be repayable over the period of the Agreement.

(*d*) As soon as a loan is approved and the applicant is ready to commence the work, one-fifth of the loan can be paid out to him to make a start. The balance of the loan is paid out on certificates issued from time to time by an Irrigation Engineer, stating that the work is being satisfactorily carried out and that the value of the completed portions is not less than the instalments required.

(*e*) Cement required on works for which a loan has been obtained is procurable at 2s. 6d. per pocket (95 lbs.) through the Director of Irrigation or Irrigation Engineer (Matabeleland).

Tools and plant purchasable with the loan may also be obtained through these officials.

(*f*) If a loan is obtained for water conservation works, the amount which normally would be repayable may be reduced by a rebate. The conditions applying to such rebates are set out in this bulletin under the heading "Subsidies on Water Conservation Works," paragraph (*e*).

Green Manuring and Artificial Fertiliser Loans.—These loans are obtainable from the Land and Agricultural Bank of Southern Rhodesia and are made under conditions recommended by the Soil Conservation Advisory Councils. The loans are made for the purpose of meeting the cost of green manuring and fertilising of lands which have been badly eroded and which have subsequently been suitably protected by contour ridges, but which are judged to be incapable of producing a cash crop without this treatment.

Application forms can be obtained from the Land Bank, and when completed must be submitted in the first place to the Secretary, Department of Agriculture and Lands.

All applications are subsequently considered by the Finance Sub-Committee of the Soil Conservation Advisory Councils, and if recommended are then passed to the Manager of the Land Bank.

Applicants are strongly recommended to obtain, from their local Soil Conservation Committee, a brief report certifying that the lands to be treated are suitably protected by soil conservation works, and are in need of either or both green manuring and fertilising.

The conditions under which these loans are made are:—

(*a*) Loans require, in the first instance, to be recommended by an officer of the Department of Agriculture, or by the local Soil Conservation Committee, or by both.

(*b*) The loans are made on the best security available to the Land Bank, subject to the applicant being satisfactorily reported on.

(*c*) Interest is charged at the rate of 5% per annum, payable half-yearly in arrear, the first payment of interest being due six months after the date of issue of the loan.

(*d*) The capital is required to be repaid in six half-yearly instalments, the first instalment being due 3½ years after the date of issue of the loan.

(*e*) The maximum amount of a loan in any one year for any individual farm is £100.

Subsidies on Water Conservation Works.—In order to encourage the construction of water conservations works, subsidies or rebates are granted in respect of a portion of the cost of such work.

Applications for these subsidies or rebates must be made in the first instance to the Director of Irrigation or the Irrigation Engineer (Matabeleland), as an inspection of the work by an Irrigation Engineer is necessary in order that he may submit the necessary certificate.

The conditions under which these subsidies and rebates are obtainable are as follows—

(*a*) They will be granted only in the case of schemes involving the storage of water. They WILL NOT be granted in respect of pumping schemes, ordinary irrigation diversion schemes or schemes for the exploitation of underground water supplies.

(*b*) The amount of the subsidy or rebate is 25% of the actual cost of the storage work and is limited to a maximum of £62 10s. 0d. per individual farm.

(*c*) Subsidies or rebates will only be paid on completion of works approved by the Irrigation Department after an inspection and valuation. If the inspection is carried out by an Engineer during the course of an ordinary tour no charge is made, but should an applicant desire a special visit for the inspection, the cost of such a visit is deducted from the subsidy or rebate granted.

(*d*) Subsidies or rebates apply ONLY to approved water conservation works, which were in progress on the 1st January, 1936, or have been constructed since then.

This grant of subsidies or rebates applies only up to the 31st December, 1940, and consequently the construction of schemes by persons desirous of obtaining such rebates must be completed before this date.

(*e*) In cases where irrigation loans have been granted for the construction of storage works, the total amount of the loan, which otherwise would be repayable, will be reduced by the amount of rebate granted.

Supply of Cement at Reduced Rates.—Arrangements have been made by the Premier Portland Cement Company (Rhodesia) Ltd. whereby farmers who do not desire a loan and are willing to pay cash for the cement required, may obtain cement at reduced rates and on completion of the work will receive a rebate from the Cement Company.

The following conditions apply to obtaining cement in this manner:—

(*a*) A cheque in favour of the Premier Portland Cement Company (Rhodesia) Ltd. must first be sent to the Director of Irrigation or the Irrigation Engineer (Matabeleland).

This cheque must cover the initial cost of the cement at initial rate, plus railage charges if the cement is to be consigned to a siding where the sender is forced to prepay the railage charges.

If the cement is consigned to a station where prepaid railage charges are not necessary, the cement can be despatched "carriage forward" and the farmer will then have to pay the railage charges on receipt of the cement.

(*b*) The initial rates are 3s. 0d. per pocket (95 lbs.) for quantities less than 50 pockets, and 2s. 10d. per pocket for lots of 50 pockets and over.

The minimum quantity which can be obtained is 24 pockets—and this quantity must be on one order and in one delivery .

(*c*) After an inspection of the works by an Irrigation Engineer, a certificate is issued to the Cement Company to the effect that all the cement has been utilised in the construction of water conservation works only. The Cement Company will then forward the rebate to the farmer.

The amount of the rebate is the difference between the price initially paid and a reduced price of 2s. 6d. per pocket, thus making the actual final cost of the cement 2s. 6d. per pocket.

Loan on Ditching Implements.—Arrangements have been made whereby Farmers' Associations, approved groups of farmers or individual farmers, may obtain ditching implements on loan from the Government, free of hiring charge, for the construction of contour ridges.

The conditions under which these implements are available are as follows:—

A. *To Farmers' Associations or Groups of Farmers*:—

(1) The Farmers' Associations or group of farmers must make itself responsible for the upkeep and maintenance of the implement.

(2) The Association or group must render monthly returns in duplicate to either the Director of Irrigation or Irrigation Engineer (Matabeleland) giving the time spent and the length of ridges constructed on each farm.

(3) The Association or group is responsible for the delivery of the implement from either Salisbury or Bulawayo to its centre and for its eventual return.

(4) The choice of type of implement is left to the Association or group.

B. *To Individual Farmers*:—

(1) This shall apply only to areas in which no Farmers' Association exists.

(2) The farmer must render returns either to the Director of Irrigation or the Irrigation Engineer (Matabeleland) giving the time spent and the length of ridges constructed on his farm.

(3) The farmer must make himself responsible for the removal of the implement from Salisbury or Bulawayo and for its return in good condition, exclusive of fair wear and tear.

(4) When available, the farmer has the choice of the following implements:—

Salisbury: Lockie, Morris and Martin ditchers.
Bulawayo: Dam scraper, Martin ditcher or Morris heavy duty ditcher.

(5) The period during which an implement may be made use of by a farmer shall not exceed 14 days, unless written permission is obtained from either the Director of Irrigation or the Irrigation Engineer (Matabeleland). Such extensions will depend on the number of applications outstanding.

Internal Parasites in Sheep.

By PERCY D. HUSTON, M.R.C.V.S., District Veterinary Officer.

The following note is written with the intention of assisting stockowners to diagnose and treat the commonest forms of internal parasites affecting sheep in Southern Rhodesia.

Clinical Appearance of a Worm Infested Flock.—The sheep do not thrive, become poor, and even emaciated if the infestation is severe. On examination they are found to be anaemic (shown by the white colour of the mucous membranes of the eyes and mouth). Swellings appear in the dependant parts of the body, particularly under the jaws (so called bottle jaw) and the animal may appear pot-bellied. Digestive disturbances may take place, the animal developing either diarrhoea or, rarely, constipation. In summer, when the grazing is good, sheep may withstand infestation; but in the dry season the animals fall off rapidly in condition and may die in large numbers. In acute hookworm infestation deaths may occur in fat sheep.

Diagnosis.—A *post-mortem* examination is the only way of making a definite diagnosis, and the following is a list of the commonest worms showing where they are found, their size and a short description of each, which will enable the various species to be identified.

The identification of the species is necessary because the treatment of each is different.

Name.	Where Found.	Length.	Appearance.	Treatment.
Wireworm	4th stomach	over 1 inch	Thickness of ordinary needle, females show spiral striations like a barber's pole, often seen as reddish-brown mass clustered in fourth stomach.	Government wireworm remedy, nicotine and bluestone remedy and nodular worm remedy.
Nodular	Large intestine specially Caecum and Colon	1 inch	White in colour, thickness of darning needle, straight and stiff, front end slightly bent like a hook. Characteristic nodules can be seen in wall of gut where young worms have burrowed.	Nodular worm remedy. Two treatments at 6 weeks interval recommended.
Bankrot	1st few feet of small intestine near 4th stomach, occasionally in 4th stomach	$\frac{1}{4}$ inch	Almost colourless, thin as a hair; to detect worms the inside of the intestine should be scraped with a knife and scrapings smeared on a piece of glass and held up to the light.	Nicotine and bluestone remedy

Name.	Where Found.	Legnth.	Appearance.	Treatment.
Hook-worm Bonostimes	Last portion of small intestines	$\frac{3}{4}$ inch	Being blood suckers are pinkish in colour, nearly as thick as a darning needle, are firmly attached to the bowel wall sucking blood. In portions of bowel where worms are found numerous small blood spots or haemorrhages may be seen indicating where worms were attached.	Tetrachlorethylene emulsion proceeded by $2\frac{1}{2}$ cc of a 10% solution of copper sulphate. Treatment, three times at ten to fourteen days' interval.
Gaigeria	First portion of small intestine	1 inch		
Fluke	Bile ducts of liver	2 inches long $\frac{1}{4}$ to $\frac{3}{8}$ broad	Tongue or leaf-like in shape, brownish in colour. Liver shows thickening of bile ducts due to presence of parasites.	Carbon tetrachloride.
Tape Worm	Small intestine	Up to 15 feet long $\frac{1}{4}$ to $\frac{1}{2}$ inch broad	Whole worm looks like a segmented piece of tape. The segments are $\frac{1}{4}$ to $\frac{1}{2}$ inch wide and about $\frac{1}{4}$ inch long.	Nicotine and bluestone remedy

DETAILS OF TREATMENT.

Nodular Worm Remedy.—Complete with dosing spoons and instructions are obtainable from the Director of Veterinary Research, Salisbury.

Nicotine and Bluestone Remedy.—This is made by dissolving 1 oz. of copper sulphate (bluestone) and 1 oz. of liquid tobacco extract containing 40% nicotine in three pints of water and the dose of this mixture is:—

From 1— 3 months	¾ oz.	If sheep in poor condition	½ oz.
,, 3— 6 ,,	1 oz.	,, ,, ,,	¾ oz.
,, 6—12 ,,	1½ oz.	,, ,, ,,	1 oz.
Over 12 months	2 oz.	,, ,, ,,	1½ oz.

Tetrachlorethylene.—Emulsion, called "Tetram," is obtainable from the Director of Veterinary Research, Salisbury. The emulsion is diluted with an equal part of water and the dose of the dilution is:—

10 cc for lambs 3 to 6 months old.
15 cc for lambs 6 to 12 months old.
20 cc for sheep over 12 months old.

Only a small quantity of the emulsion should be diluted at a time, about two cupfuls.

A dose of 2½ cc of a 10% solution of copper sulphate should be given *immediately* before the mixture; sheep should be dosed three times at 10-14 days interval. Ten per cent. solution of copper sulphate is made by dissolving 2 ozs. copper sulphate in 1 pint of water. The sheep should be kraaled at night, and then treated early in the morning. It is not necessary to keep them from food or water after the treatment, but they should be kept in the shade for some time after.

Carbon Tetrachloride.—A mixture is made of 1 part of carbon tetrachloride and 4 parts of liquid paraffin or milk and the dose of the mixture is:—

Up to 12 months old	5 cc
Over 12 months old	10 cc

It is advisable for 14 days prior to dosing sheep with carbon tetrachloride to give them bone meal ½ oz. per day.

Government Wireworm Remedy is supplied by the Director of Veterinary Research; but, as this remedy is only of service in wireworm infestation, and both the nicotine and bluestone remedy and nodular worm remedy are effective against wireworm, this remedy may be dispensed with.

PERIOD OF DOSING.

All sheep should be dosed at intervals of three weeks.

To find out what treatment should be given a *post mortem* examination should be held on an animal and then the flock should be treated with the remedy recommended for the species of worm which is found to be predominant.

In cases where this is impossible the following table has been drawn up as a suitable routine treatment.

NO=Nodular Remedy.
N.B.=Nicotine and Bluestone.

The number in between is the number of weeks from the commencement of the treatment.

1st week NO.	3rd NB.	6th NO.	9th NB.	12th N.B.
15th NB.	18th NO.	21st NB.	24th NO.	27th NB.
30th NB.	33rd NB.	36th NO.	39th NB.	42nd NO.
45th NB.	48th NB.	51st NB.		

In the above table the sheep are treated regularly every three weeks.

They get six nodular worm treatments during the year in three series, each consisting of two doses at six weeks interval, which is the period recommended.

If hookworms are suspected a treatment for these could be given by not administering the nicotine and bluestone remedy on the 12th and 15th weeks and instead substituting the tetrachlorethylene remedy on the 12th, 14th and 16th weeks. A similar substitution could take place on the 30th and 33rd weeks, giving tetrachlorethylene on the 30th, 32nd and 34th weeks or on the 48th and 51st weeks, giving it on the 48th, 50th and 52nd weeks. This complete cycle starts again on the 54th week, which becomes the 1st on the table.

The Life History of Root Gallworm or Root Knot Eelworm.

By M. C. Mossop, M.Sc., Entomologist.

As the eelworm problem is becoming more pressing in Southern Rhodesia, due to the practice of growing susceptible crops continuously, or without a proper rotation including bare fallow, it is thought that a short description of the life history of nematode,* otherwise called root knot eelworm or root gallworm, will be welcomed. This eelworm belongs to a large group of small animals known as eelworms, roundworms, threadworms, or nematodes, comprising parasites of animals, such as hookworm, underground parasites of plants, such as root gallworm, aerial parasites such as "Cockles" on wheat, and non-parasitic, free-living forms found in decaying organic matter. The root gallworm is a parasite only in certain stages of its development, though if several generations occur in the same gall, it remains parasitic all its life.

Figures of linear measurement and time given below are approximate, in most cases more or less representing a mean between extremes given by various authors working in different countries.

The egg is less than 1/250th of an inch long. It is covered with a tough skin making it somewhat resistant to chemical treatment or adverse soil conditions. Under suitable soil conditions, including warmth and moisture, it hatches in less than a week.

The egg hatches into a minute elongated worm-like larva about 1/70th of an inch long by 1/2,000th of an inch thick, invisible to the unaided eye. Although this young eelworm is active, it cannot move more more than an inch a day by its

Heterodera marioni (Cornu) Goodey, previously known, *inter alia*, as *H. radicicola* (Greef) Müller.

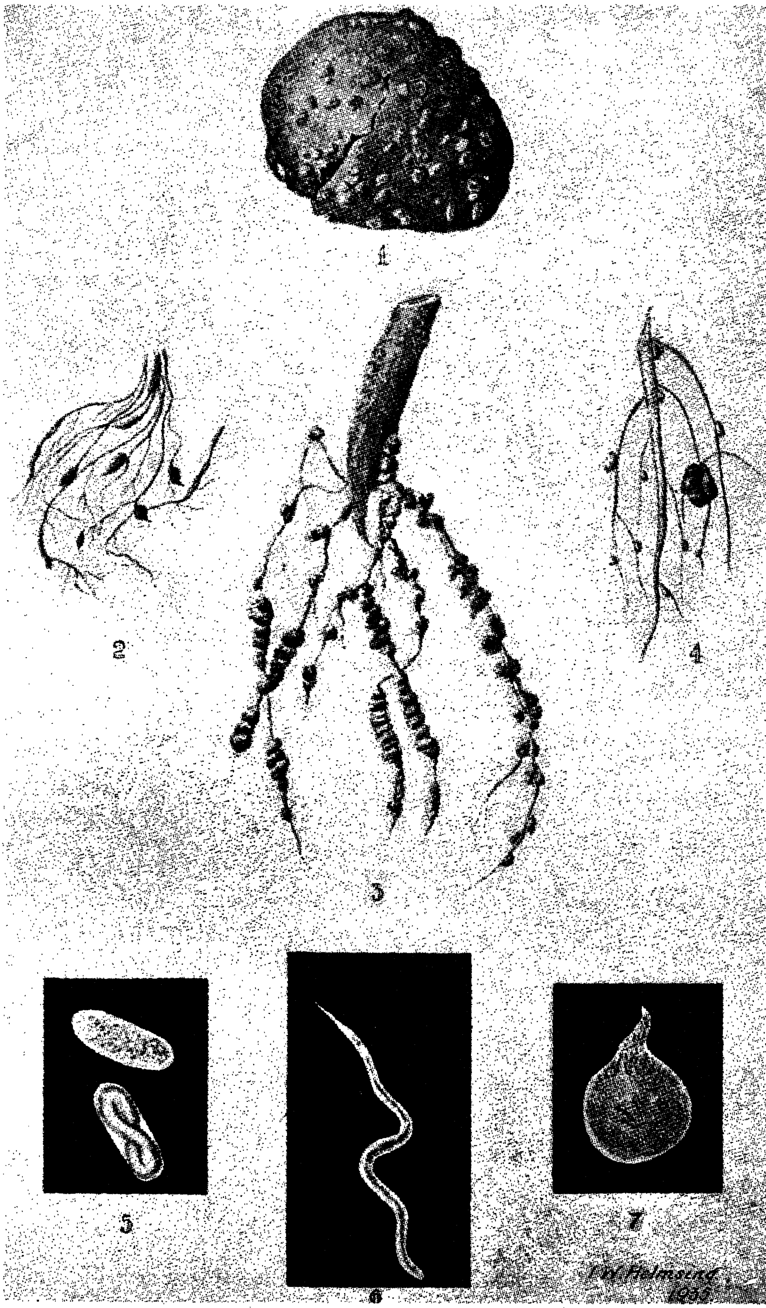


Fig. 1—Potato showing eelworm nodules. Fig. 2—Strawberry roots showing eelworm nodules. Fig. 3—Tomato roots showing eelworm nodules. Fig. 4—Lupin roots showing bacteria nodules. Fig. 5—Eggs of eelworm (x 150). Fig. 6—Eelworm larva. Fig. 7—Adult female eelworm.
(Queensland Agricultural Journal).

own efforts through the soil. However, outside influences such as wash by storm water or other incidental, accidental, or intentional transport of infested soil, may increase this distance to many miles. In fact, all stages of eelworm can now be carried across continents in a very short time with commercial products. On finding a suitable young root the larva bores into it near the feeding tip and then practically ceases activity and commences to grow, feeding on the plant juices that surround it. The chemical or mechanical irritation it produces, or direct cell injury caused by the piercing stylet, affects the root tissue and stimulates cell proliferation in such a way that swelling of the root results. The swelling, which is similar to a tumour, may grow to several times the thickness of the root near that point, or it may be hardly visible. It may be on the side of the root or all round it, depending on the degree of infestation and the variety of the plant.

The swellings or galls should not be confused with the nodules produced on legumes and a few other plants by "nitrogen-fixing" bacteria. The nitrogen nodules are usually connected with the root by a short neck or stem, and can be broken off. The gall caused by eelworm is more obviously a part of the root itself.

The eelworm passes through several stages during growth. After fertilisation the adult female eelworm enlarges to a more or less pear-shaped, pearly, white body measuring about 1/40th to 1/25th of an inch, and can be seen with the naked eye in a gall that has been carefully broken open, or in infested potatoes. It takes about a month to develop, and remains in the gall. The fertilised female eventually becomes little more than a sac of 60 to 500 eggs, Southern African authors and investigators inclining to low figures such as 60 to 100. The eggs usually hatch within the body of the female and the young larvae remain there until they are liberated into the soil by the breaking down of the parent's skin and the decay of the gall.

The male, after feeding, retains its worm-like shape, but, although growing to well over 1/30th of an inch long, it remains practically invisible on account of its slender width of 1/800th to 1/700th of an inch.

Less is known of the habits of the male. It is agreed, however, that the male can again become a free-living, active organism after attaining the adult stage, and that it apparently either seeks out a female in the same gall before departing, or finds a mate by making its way through the soil to another root.

The time occupied in the completion of a generation varies with the soil conditions, especially temperature and moisture. A month to six weeks is generally regarded as necessary under average favourable conditions. In countries where it is hot throughout the year there are believed to be 10 to 12 generations annually.

Where temperature and moisture and chemical conditions generally are unsuitable for development without being extreme, development is retarded or arrested. Eggs are said to encyst and in this condition be able to survive for two years. Under otherwise suitable conditions, but with no roots available, larvae can survive for about the same period. The factor inhibiting serious eelworm infestation in crops grown during the winter in Southern Rhodesia is believed to be insufficient heat in the soil, as moisture and food are both made available where winter crops are grown.

Root knot eelworm flourishes in tropical, sub-tropical and temperate climates, and in greenhouses. A loose, sandy soil is more favourable to it than a heavy soil with clay sub-soil. In the lighter types of soil and sub-soil eelworm may sometimes be found down to about three feet, but there are levels of maximum concentration which vary with the soil and rooting habits of the plants grown in it, and also seasonally.

The susceptibility and resistance of plants, and some control measures for eelworm, have been dealt with elsewhere in this *Journal*, notably in June, 1913, pp. 676-679 (Bulletin No. 147 out of print); May, 1937, pp. 368-374 (Bulletin No. 1026) and pp. 409-416; April, 1938, pp. 264-278; and June, 1938, pp. 431-438 and pp. 448-451. As work progresses at the Experiment Station at Trelawney it is hoped that further information on the subject will become available.

Report on Experiments, Season 1936-37

SALISBURY AGRICULTURAL EXPERIMENT STATION.

By H. C. ARNOLD, Manager.

The season opened very favourably and early sown crops made rapid progress at first, but from the beginning of December until well past the middle of January, the droughty conditions which prevailed retarded the growth of the early sown crops and caused gaps in the stands of the later sowings. The precipitation during the latter part of January and during February was abundant, and the hardy crops such as maize, recovered somewhat from the unfavourable effects due to lack of rain in the earlier part of the season. During March droughty conditions prevailed again, and the late sowings were adversely affected.

Analysis of Rainfall: Season 1936-37.

Month.	Number of rain days.	Total for the month.	No. of rains over ¼ of an inch.	Total to end of month.	Periods exceeding one week without rain.
October	8	1.89	3	1.89	
November ...	12	4.50	8	6.39	Nov. 2nd to Nov. 12th
December ...	8	2.51	3	8.90	Dec. 17th to Dec. 24th
January	14	9.61	10	18.51	
February... ...	18	9.56	12	28.07	Feb. 25th to Mar. 6th
March...	6	2.82	2	30.89	Mar. 16th to Mar. 26th
April...	5	1.79	2	32.68	Apr. 5th to Apr. 16th.
Totals	71	32.68	40		
Average for previous 10 years	72	27.76	34		

This analysis shows that the total rainfall was nearly five inches more than the average for the previous ten years, but its distribution was so uneven that the crops were not able to make the best use of it.

The results of experiments conducted at this Station since 1919-20 are available in bulletin form, and to facilitate comparison, this report is drawn up on similar lines to previous ones.

Having served their purpose the following experiments were discontinued:—

(1) Trials with varieties of wheat for summer cultivation;

(2) Comparison of the effect on the yields, of ridging the ground-nut crop at different stages of its growth.

New investigations commenced were as follows:—

(1) Comparison of hay yields of dolichos biflorus with those of sunnhemp and soya beans.

(2) Linseed varieties for fibre production.

CROP ROTATION EXPERIMENTS.
FIRST SERIES 1913-1937.

Maize Yields in Bags per Acre.

System of Cropping.	1936-37 Rainfall 32.68	1935-36 Rainfall 24.01	1934-35 Rainfall 31.07	1933-34 Rainfall 31.54	1932-33 Rainfall 27.64	1931-32 Rainfall 26.62	1930-31 Rainfall 31.47	Average Yield.
*A1—Maize continuous. Green manure and 250 lb. per acre of phosphatic fertiliser in the seasons 1928-29, 1932-33 & 1935-36	16.10	Green Manure ploughed under.	4.99	19.04	Green Manure ploughed under.	9.60	12.60	13.03 (6 crops)
*A2—Maize continuous. Fertiliser only, rates as above.	9.10	6.12	2.01	8.74	3.53	10.92	2.99	6.78 (9 crops)
†B—Alternate maize and beans for hay; no manure or fertiliser.	5.60	11.70	4.45	6.60	2.34	10.02	1.95	9.16
C — Three-course rotation: Maize, velvet beans (reaped), oats; no manure or fertiliser.	5.80	13.25	5.82	10.75	4.90	11.10	11.70	13.09
D — Four-course rotation: Maize (plus 6 tons dung per acre), oats, bean hay, maize. Average of two plots.	14.30	14.82	6.81	14.70	14.21	16.33	14.93	
Maize (no manure direct).	14.70	16.63	6.82	11.90	14.40	14.80	14.95	16.85 (21 year)
Maize (dunged plots)	13.90	13.00	6.80	17.50	14.02	17.85	14.90	16.92

*NOTE.—Having grown maize for 15 years in succession without manure or fertiliser, during which time its yields had gradually decreased until they had become so low as under practical field conditions to have rendered them negligible, this plot had served its purpose. With the object of comparing two methods of again raising the cropping power of such land to a more profitable standard, the whole plot was treated with a mixture of one-third bone meal and two-thirds superphosphate at the rate of 250 lbs. per acre, at the beginning of 1928-29. One-half of the plot was then planted to maize while the other half was sown to a mixture of sunnhemp and velvet beans, which were subsequently ploughed in. This manurial treatment was repeated on the respective plots during the seasons 1932-33 and 1935-36.

†In 1929-30 this system was amended from "Alternate Maize and Bare Summer Fallow' to "Alternate Maize and Beans for Hay."

System A.—The two methods of raising the fertility of this land have now been under trial for nine years. The sub-plot which receives green manure in addition to phosphatic fertiliser has produced six crops of maize during that period, the other three seasons having been taken up by the green manure crops. The six crops grown on this land have produced 78.21 bags of maize per acre, but on the other sub-plot nine crops have produced only 61.05 bags per acre. This gives a balance of 17.16 bags per acre in favour of the green manurial treatment.

System B.—The yield of maize recorded here this season, *viz.*, 5.60 bags per acre, seems low when it is compared with that of other plots, but it must be remembered that this land has been in cultivation for 24 years and has never received manure or fertiliser in any form. The previous yields of this plot are seen to be as follows:—4.45 bags per acre (season 1934-35), 2.34 bags per acre (season 1932-33), 1.95 bags per acre (season 1930-31). It is apparent therefore that the crop producing ability of this land has progressively increased since the system of cropping was changed from maize alternating with bare-fallow to maize alternating with beans for hay. Despite the removal of a certain amount of plant food from the land by the bean crop, it deposits a beneficial residue in the soil which enables the following crop of maize to grow more luxuriantly than it would have been able to do if no bean crop had preceded it.

System C.—Although the yield of maize is not high this season, the stabilising effect which the other crops in the rotation have had, is apparent when the yield is compared with those of other single-crop systems in previous unfavourable seasons. This land has yielded a crop each year since it was first brought into cultivation 24 years ago and no manure or fertiliser has ever been applied to it. The beneficial effect of the bean crop is not fully reflected by the maize yields because the oat crop intervenes and takes the first toll of the legacy left by the legume.

System D.—The returns obtained from these plots strikingly illustrate the beneficial effect of a balanced system in which the crop residues are used to feed the livestock, and the livestock by-products are used to feed the crops. The effect of the

treatments is best judged by comparison with the yields recorded for the season 1932-33, during which the same plots carried the same crops. It is seen that this season's yields are about equal to those obtained four years ago, and this indicates that the fertility level of this soil has not been seriously lowered by the four crops which have been taken from it in the meantime. A rotational system in which the crops are fed to the farm livestock, and the farmyard manure is carefully preserved and used to maintain the fertlity of the land, is seen to be the soundest basis for a permanent agricultural industry.

SECOND SERIES OF CROP ROTATIONS.

These rotations were laid down in 1919-20 and were designed to evolve a system of cropping which would meet the needs of farmers who could not adopt mixed farming. The series included two plots, A. and F., on which maize was grown continuously for ten years without manure or fertiliser to serve as checks on the results from the rotations. For this purpose the cropping of Plot A. continues as in the past, but on Plot F. commencing season 1929-30, fertiliser is applied in alternate years. The fertiliser treatment given to this plot is the same in quantity and quality as that accorded in rotational System H., but green-manuring is entirely omitted.

Plot A: System E.—Maize continuous without manure or fertiliser.

Seasons and Yields of Maize in Bags per Acre.

1936-37.	1935-36.	1934-35.	1933-34.	1932-33.	1931-32.	Average over 18 years.
3.80	6.88	2.21	4.60	1.74	11.60	9.30
24	31	20	20	15	27	Rain days in Feb. & March.
12.38	11.98	7.31	7.50	5.19	6.86	Total rainfall Feb. & March in inches.

The relationship between the yields of maize and the incidence of the rainfall during the months of February and March is well illustrated by the returns from this plot. When the rain is spread evenly over these two months it is more effective than when heavy storms alternate with droughty periods. Farmers who fail to maintain the humus and

phosphate content of their soils, experience violent fluctuations in their yields of maize from season to season and the return for their expenditure is subject to the capriciousness of the uncertain rainfall.

Plots B to E: System F.—Three-quarters of the land under maize, one quarter under Sudan grass. Each year one section under maize, commencing with Plot B in 1919-20, receives eight tons of farm manure per acre, and commencing on Plot E in 1929-30, the section which grew Sudan grass the previous season receives 200 lbs. per acre of superphosphate (19 per cent. P_2O_5).

Maize Yields in Bags per Acre

	1936-37	1935-36	1934-35	1933-34	1932-33	1919-20	Average 1920-37
Plot B	11.50	19.55*	7.19†	Sudan	9.72	26.0	16.75
Plot C	14.75*	15.93†	Sudan	15.45	10.75*	23.7	15.34
Plot D	15.25†	Sudan	6.05	18.80*	11.05†	Sudan g	15.72
Plot E	Sudan	16.68	6.99*	17.73†	Sudan g	24.6	15.99
Average	13.83	17.39	6.74	17.33	10.51	24.7	15.95

*Indicates the application of farmyard manure.

†Indicates the application of 200 lbs. per acre superphosphate.

The average annual yield of maize obtained from these plots since applications of phosphatic fertiliser were commenced is 13.88 bags per acre, and this is practically the same as the yield recorded this season. This indicates that the drain on the natural fertility of this land which occurred before dressings of phosphate were included in the manurial treatment, has been checked, but the amounts applied appear to be the minimum required in a system which takes three crops of maize off the land every four years.

Plot F: System G.—Maize continuous. No manure or fertiliser during the first ten years. Commencing season 1929-30, fertiliser consisting of one-third bone meal and two-thirds superphosphate at the rate of 200 lbs. per acre is applied every alternate year.

Seasons and Yields of Maize in Bags per Acre.

1936-37	1935-36	1934-35	1933-34	1932-33	1931-32	1919-20	Average over 18 years
6.65	15.26*	3.70	14.55*	5.33	21.08*	23.3	11.28

*Indicates the application of 200 lbs. per acre fertiliser.

The synchronisation of favourable climatic conditions with the applications of fertiliser, has caused the wide alternations recorded for this system. By comparing the yields obtained on this plot with those of Systems F and H the stabilising effect of additions of humus to the soil either in the form of farmyard manure, or as green manure, can be ascertained, and it follows that farmers who rely on applications of chemical fertilisers only, for the maintenance of the fertility of their lands, are likely to be sorely disappointed when the rainfall is unevenly distributed, or when it varies much above or below the normal amount.

Plots G to K: System H.—Three-quarters of the land under maize, one-quarter under velvet beans, which are ploughed under for green manure. From the commencement of this experiment until 1928-29 this land received one green manuring and one application of fertiliser during each period of four years. The returns from these plots showed that insufficient plant food had been supplied to maintain fertility, and the manurial system was then amended to provide for two dressings of fertiliser during each four-year period. The crop of maize which follows the green manuring now receives 200 lbs. of 19 per cent. superphosphate per acre, which should enable it to make better use of the nitrogen supplied by the green manure; the second maize crop receives no fertiliser, and the third crop, that immediately in front of the green crop, receives 200 lbs. per acre of a mixture of bone meal and superphosphate.

Maize Yields in Bags per Acre.

	1936-37	1935-36	1934-35	1933-34	1932-33	1919-20	Average 1920-37
Plot G	11.20*	14.78	14.58*	Beans	5.94*	23.10*	14.51
Plot H	9.90	20.28*	Beans	14.50*	9.32	23.00	15.46
Plot J	20.56	Beans	4.34	12.25	10.65*	Beans	14.11
Plot K	Beans	15.35*	3.59	19.65*	Beans	19.20	14.24
Average	13.89	16.80	7.50	15.47	8.63	21.70	14.58

*Denotes application of fertiliser.

The remarkably beneficial effect of green manure combined with phosphatic fertiliser, is strikingly demonstrated by the results recorded in this experiment. On Plot J, for instance, despite an application of fertiliser, the yield was as

low as 4.34 bags per acre, in the season 1934-35; in the following season the plot was green manured and in the season under review, fertiliser was again applied and a yield of 20.56 bags per acre resulted. On all the other plots in this rotation similar results have been obtained.

In the following tabulation the yields recorded in System H during the past seven years, are arranged in the order in which they occur after the green manurial treatment. They indicate that high yields of maize may almost invariably be obtained when the land is dressed with phosphate following the application of green manure, but that in the third season after the green manuring, the fluctuations in the yields are influenced more by the incidence of the rainfall during the months of February and March, than by the application of phosphatic fertiliser.

Maize Yields in Bags per Acre in Seasons 1930-31 *to* 1936-37.

	Fertiliser treatment per acre.	Season 1930-31	Season 1931-32	Season 1932-33	Season 1933-34	Season 1934-35	Season 1935-36	Season 1936-37	Average 1930-37
Season after reen manure.	200 lbs. supers	16.8	22.5	10.7	19.7	14.6	20.3	20.6	17.9
l Season after reen manure.	No fertiliser	7.5	12.8	9.3	14.5	3.6	14.8	9.9	10.3
Season after reen manure.	200 lbs. bone & super	6.1	16.5	5.9	12.3	4.3	15.4	11.2	10.2
in days in Feb. nd March		17	27	15	20	20	31	24	

NEW ROTATIONAL SYSTEMS.

In the season 1926-27 two new rotational systems were laid down, which have been designated Systems M & O respectively.

System M.—This is a four-course rotation in which the sequence of the crops is:—Maize+200 lbs. per acre of superphosphate; ground nuts and sunflowers; maize+200 lbs. per acre of bone and superphosphate; green manure. Hence one-half of the land is sown to maize, one-eighth to sunflowers and

another eighth to ground nuts, and one-quarter is green manured. In the following tabulation the yields of the various plots are expressed in bags per acre, a "bag" of maize being 200 lbs., and a "bag" of ground nuts 65 lbs.

Seasons and Yields of Maize in Bags per Acre.

	1936-37	1935-36	1934-35	1933-34	1932-33	1931-32	1926-27	Average maize yield 1927-37
Plot A ...	N14.3	14.90*	G.M.	13.75*	N14.00	17.20	G.M.	13.12
Plot B ...	15.72*	G.M.	5.55*	N14.30	10.15	G.M.	15.15*	11.72
Plot C ...	G.M.	12.50*	N8.8	12.60	G.M.	15.05*	N21.0	13.42
Plot D ...	14.88*	N15.70	7.95*	G.M.	8.05*	N11.0*	12.06	11.74
Average Maize yield.	15.30	13.70	6.75	13.17	9.10	16.13	13.88	12.16

*Denotes the application of fertiliser.

G.M. Denotes the application of green manure.

N. Denotes the position of the ground nuts in the rotation.

This season the average maize yield in this rotation is higher than any recorded since the season 1931-32, and for the first time since the two systems H and M were placed on an equal basis as regards fertiliser treatment the maize yield of System M has exceeded that of System H. These results corroborate those observed in System C and D, where crops other than maize in the rotation exert a beneficial effect, which is reflected by comparatively high yields during unfavourable seasons.

System O.—The order of rotation is:—Maize fertilised with 200 lbs. per acre of bone and superphosphate; sweet potatoes; maize which receives a dressing of 8 tons per acre of farmyard manure; hay crops. This system is typical of a rotation suitable for dairymen or others who prefer to feed a large proportion of their crops to livestock. In practice it would probably be found necessary to make alterations to meet individual requirements, such as altering the proportion of maize to other crops; leaving the sweet potatoes down for two years, or reducing the amount of land under sweet potatoes, and growing pumpkins and melons instead. Whatever the details of the adopted system may be, if the principles on which this rotation is based are adhered to, similar results could be expected.

In the tabulation below are shown the acre-yields of maize in bags of 200 lbs. and of bean hay and sweet potatoes in tons.

Seasons and Yields in Bags (or Tons) per Acre.

	1936-37	1935-36	1934-35	1933-34	1932-33	1926-27	Average maize yield 1926-37
Plot F...	P 1.02	19.32*	H 3.8	19.18†	P 3.6	H 1.1	17.83
Plot G...	15.61*	H 1.4	11.58†	P 5.5	9.10*	19.65	15.17
Plot H...	H 2.29	17.78†	P 5.65	20.80*	H 0.56	P 6.1	18.24
Plot J...	14.85†	P 3.70	9.84*	H 2.5	9.95*	16.45*	13.65
Average of maize plots	15.23	18.55	10.71	19.99	9.53	18.05	16.22

*Denotes the application of fertiliser.

†Denotes the application of farmyard manure.

P Denotes the position of the sweet potatoes in the rotation.

H Denotes the position of the bean hay crop.

In spite of the climatic conditions being somewhat unfavourable, the maize produced on these plots is only one bag per acre less than the average of the yields recorded during the eleven years since the trial began. The sweet potato yield for this season is very low owing to a poor stand, due to the droughty conditions which continued for several weeks after the cuttings were planted. The yield of 2½ tons per acre of legume hay may be considered very satisfactory.

The results obtained in these trials show that, although it is impossible to control weather conditions, much can be done to minimise the effect of unfavourable seasons, by balanced systems of rotational cropping and manuring with farmyard manure, with the addition of adequate applications of phosphatic fertilisers.

It is noteworthy that heavy yields of legume hay have been obtained each season for the past four years, since the change was made from dolichos beans to a mixture of Biltan soya beans and Somerset velvet beans. The method employed is to first sow the Biltan beans early in December, in rows three feet (approximately) apart; about three weeks later, this crop is cultivated to destroy the weeds and the velvet beans are sown between the rows. In this way the Biltan beans are given a lead over the velvet beans and are thus enabled to withstand the latter's aggressive competition. The soya

beans make sturdy upright growth, which supports the trailing vines of the velvet beans, and the crop is cut when the soya beans reach the early podding stage, at which time the pods of the velvet beans are too small to retard the curing of the fodder. The reaping of the crop is much facilitated by the presence of the Biltan beans, whose upright habit of growth keeps the trailing vines of the velvet beans off the ground, so that the cutter bar of the mowing machine is able to operate underneath the mass of growth, without becoming entangled in it.

The results of two important experiments have already been reported in the October, 1937, issue of the *Rhodesia Agricultural Journal*. One showed that the early ploughing under of the green manure crop is not conducive to the best results, and the other indicated that heavier crops of maize are likely to follow a sunnhemp crop which is seeded at the rate of 40 lbs. per acre, than is the case when smaller quantities of seed are used.

Methods of Utilising the Sunnhemp Crop for the Restoration of Soil Fertility.—The beneficial effect on the maize crop, which follows the ploughing under of sunnhemp, is now generally recognised, and the periodical green-manuring of land in this way, is accepted as part of the necessary routine by the majority of the farmers who grow maize extensively in this Colony. Observations by farmers, and experiments conducted at this Station have shown, however, that even when the sunnhemp crop is removed, leaving only the roots to be ploughed under, the beneficial effect is almost as great as when the whole crop is returned to the soil. Apart from the possibility of using the top growth for feeding to cattle in the form of hay or silage, or for the extraction of its fibre, the question arises as to whether there may not be more economical methods of utilising the crop in the maintenance of soil fertility, than by ploughing it directly into the soil. The comparison of the following methods was commenced in the season 1935-1936:—

(*a*) Ploughing under the whole sunnhemp crop in the usual way.

(*b*) Composting the top growth and returning the finished compost to the same land.

(*c*) The mature growth burnt on the land.

(*d*) Top growth removed, stubble only ploughed under. Compost made from top-growth applied to adjoining land.

(*e*) Maize continuously. This land received compost made from sunnhemp stalks grown on (*d*) plots.

(*f*) Maize continuously without green manure or compost.

Each of these treatments was replicated ten times in as many randomised blocks. The sunnhemp and maize were sown on the appropriate plots on 4th December, 1935, and the top growth on the (*b*) and (*d*) plots was cut on 14th March, 1936, and allowed to wilt for a few days before being removed and made into compost by the method described in the *Agricultural Journal* for February, 1936. The yield of wilted sunnhemp stalks was 5 tons per acre, and the finished product was sufficient for a dressing of 8 tons per acre of compost. This was applied to the appropriate plots in November, 1936, and the whole of the plots in this experiment received a uniform dressing of 200 lbs. per acre of raw rock phosphate, irrespective of the other treatments, and the maize crop was sown during the latter part of that month. Favourable weather conditions prevailed at the beginning of the season. The plants on the plots on which the sunnhemp had been allowed to mature, and the top growth was subsequently burnt off, made more rapid growth than those on the other plots. Their wide leaves, dark green in colour, indicated that large quantities of nitrogen in a readily available form was present in those plots. At the end of December the plants on these plots were six to nine inches taller than those on the other plots, but at that time droughty conditions began, and continued for about a month. During that period the maize plants on the "burnt" plots were markedly more affected by the adverse weather conditions than those on the land which had received either compost or green manure. The growth of the plants on the "burnt" plots was so severely checked that they did not recover from the ill-effects until some three weeks after the rains recommenced, and by that time the growth on both the green manure and compost plots had caught up with them. The maize plants on the plots which were dressed with

compost, and on those on which the whole crop of sunnhemp was ploughed under in the green state, were only slightly retarded by the droughty weather conditions, and they soon recovered after the rains recommenced.

In the following tabulation the mean yields of the ten plots under each of the respective treatments is shown:—

Yields of Maize in Bags per Acre. Seasons 1935-36-37.

Season	A	B	C	D	E	F
	Sunnhemp ploughed under.	Sunnhemp composted & returned to the same plot.	Sunnhemp mature stubble p.u., top growth burnt off.	Sunnhemp immature stubble only p.u. Tops removed.	Maize: 1936 received compost made from sunnhemp grown on "D" plots.	Maize continuously. No humus dressing
1935-36	—	—	—	—	11.42	12.72
1936-37	16.31	19.25	16.12	14.92	14.26	10.74

The heaviest crop was produced on the land on which the top growth of the sunnhemp was composted and returned to the same land. These plots gave an average increase of 8½ bags per acre more than the yield of the "F" plots on which maize was grown in both seasons. It is seen that the yield of the "F" plots was 1.30 bags per acre more than that of the "E" plots in 1935-36; it may be assumed therefore that if the "E" plots had not received their dressing of compost, their yield would have been 1.30 bags less than that of the "F" plots in 1936-37; and so it would appear that the dressing of compost which was put on the "E" plots was responsible for an increase of 4.82 bags per acre. The yield on the "D" plots is 4.18 bags higher than that of the control (F) plots. This makes a total of 9 bags per acre increase for the combined effect of the sunnhemp roots ploughed under on the "D" plots and the top growth of the sunnhemp crop grown on the "D" plots which, after being composted, was applied to the "E" plots. This indicates that slightly better use can be made of the compost if it is applied to land which carried maize in the previous season, instead of putting it back again on to the land on which the sunnhemp grew. In practice, however, the slight gain indicated in this experiment would not bear

the cost of much extra transport. When comparing the returns from the "A" and "B" plots which show a difference of 2.94 bags per acre in favour of composting the top growth of the sunnhemp crop instead of ploughing it under, it must be remembered that these returns are for one season only, and the effect of either treatment may extend over a further period of two years or so, after which it will be possible to make a more valid comparison of the merits of the two methods.

The results of this experiment may be summarised as follows:—

Increased Yields of Maize in Bags per Acre.

Bags per acre. Increase.	Treatment.
5.57	Whole sunnhemp crop ploughed under.
8.51	Top growth composted and returned to the same land.
5.38	Mature stubble ploughed under: top growth burnt.
4.18	Immature stubble only ploughed under.
4.82	Compost made from sunnhemp stalks grown elsewhere on an equal area of land.
9.00	Stubble ploughed under on one half of the field, top growth composted and applied to the other half of the field.
0.19	Whole immature crop p.u. *versus* mature stubble only; top growth burnt off.
1.39	Whole immature crop p.u. *versus* immature roots only p.u.
2.94	Top growth composted and returned to the same land *v.* ploughing under in the usual way.

It should be noted that the sunnhemp crop was a light one (its height being only 4 to 5 feet), and it is thought that the crops usually grown in this Colony would produce considerably more compost than was obtained in this experiment. Yields of ten or more tons of compost per acre would ordinarily be obtained.

These trials are being continued in a slightly amended form. Instead of burning off the mature sunnhemp on the

"C" plots, the crop will be cut for hay when it is 10 to 12 weeks old, and the stubble will not be ploughed under until after the seasonal rains are finished. The growth on the B and D plots will be allowed to remain on the land until it is 18 weeks old, in order that it may become more mature than that employed in the trials recorded above. The reason for this change in the procedure is because the older stalks contain more woody material, and it is expected that they will yield a higher percentage of humus and have a more lasting effect than compost made from less mature material. Furthermore, the above results indicate that the more mature stubble may have a more beneficial effect on the following maize crop than a less mature stubble. The method of composting sunnhemp suggested in the November, 1937, issue of this *Journal*, and now published in Bulletin No. 1048, Section III., will be followed.

Since the above was written the returns for the maize crop on the E and F plots for the season 1937-38 have been obtained. These show an average of 2.52 bags per acre in favour of the plots which received compost two years ago. This brings the total to 7.34 bags per acre increase due to the application of 8 tons per acre of compost which was made from the top growth of the sunnhemp crop grown on the adjacent land.

Comparison of the Effect on the succeeding Crops of Maize, of Ploughing under Green Sunnhemp versus **Burning of the Mature Crop of Sunnhemp on the Land.**—Over a period of several years farmers had reported that, on occasions when it had been found impossible to plough under a crop of sunnhemp intended for green manure, and it had subsequently been burned off after reaching maturity, the crop of maize produced by that land in the following season had exceeded the crop grown on the land where the whole sunnhemp crop had been ploughed under for green manure.

Investigations were commenced in the season 1930-31 when a crop of sunnhemp was treated in three different ways, namely:—

(*a*) ploughed under for green manure when the first pods formed;

(*b*) mature crop burned on the land;

(*c*) ash returned to the land after the mature stalks had been burned elsewhere, to avoid the partial sterilising effect (if any) of burning the crop on the land.

Each method of treating the sunnhemp was replicated ten times.

The land was cropped with maize for three seasons, but during that period the returns failed to reveal any definite advantage in favour of either of the methods of treatment. In the season 1934-35 sunnhemp was again grown on this land and the previous methods of treatment were again applied to the same plots as before, excepting that on the "C" plots the green sunnhemp was sprinkled with rock phosphate at the time it was ploughed under, with a view to ascertaining the effects of this method of treatment. During the season under review the whole of this land was cropped to maize with the results shown in the following tabulation.

Yields of Maize in lbs. per Plot of 1/30 Acre.

	Green sunnhemp ploughed under in the usual way.		Green sunnhemp ploughed under after dusting with Rock Phosphate.		Mature sunnhemp burnt on the land.	
	1935-36	1936-37	1935-36	1936-37	1935-36	1936-37
	177	91	167	78	122	86
	181	65	181	83	113	86
	167	65	186	60	125	93
	181	74	173	49	112	76
	163	86	170	84	131	92
	174	88	164	79	115	86
	148	78	158	60	105	85
	139	74	142	66	118	93
	135	89	138	90	97	78
	144	94	131	83	97	68
	1,609	804	1,610	732	1,135	843
Total yield in bags per acre (two seasons)	36.20		35.13		29.67	

In the first season the yields on the "burnt" plots were definitely lighter than those of the plots on which the sunnhemp crop was ploughed under in the previous season. Field observations while the crop was growing showed that during the early stages the plants on the "burnt" plot were strikingly more healthy in appearance than those on the "ploughed under" plots, but later, when the severe drought set in, the more vigorous, sappy plants on the "burnt" plots were much more severely checked than were those on the other plots. Their colour changed from dark green to a yellowish green and they did not regain their original green colour during the whole of the season. The yields on the "burnt" plots during the season under review are seen to exceed those of the other plots in the experiment. This is probably not directly due to the treatment, but to there being a greater residue of plant food remaining in this land than there was in the other plots because of a lighter crop having been taken off it in the previous season. The combined yields for the two seasons were definitely lower where the sunnhemp was burned than where the whole of the top growth was ploughed under for green manure, and they indicate that, although satisfactory yields may follow the burning of the sunnhemp crop when climatic conditions are favourable throughout the following season, that method of treating the sunnhemp is likely to prove least effective for maintaining the humus content of the soil.

The Protein Production of Fodder Crops.—It is probable that the majority of farmers, when making arrangements for growing fodder crops intended for conservation as winter food for stock, prefer to plant cereal crops such as maize and wintersome, because these produce large quantities of fodder, and in so doing, the farmers believe they are employing their resources in the most economical manner. With the introduction a few years ago of the "Somerset" variety of sunnhemp, whose free-seeding propensities make it a suitable crop to grow for hay, the question arose as to whether it might not be more economical than our common hay crops, and it was decided to lay down trials which would include both the legume and cereal crops most commonly used for fodder purposes in this Colony, in order that their comparative value as producers of protein might be compared. The crops included in these trials were as follows:—Common sunnhemp,

"Somerset" sunnhemp, "Biltan" soya beans, "Somerset" velvet beans, maize and wintersome. Cowpeas and dolichos beans were not included because they are not reliable crops in this area.

These trials were commenced in the season 1935-36, and the crops were sown in a 6 x 6 Latin square. When the various crops had reached the stage of maturity at which they are usually reaped for fodder, they were cut and weighed, and samples of the green material were submitted to the Chemical Branch for analysis.

In the following tabulation the weights of green fodder are given, together with its chemical composition.

From these figures the yields of dry matter and crude protein have been calculated and are shown at the bottom of the respective columns.

Yields of Fodder in lbs. per Acre and Chemical Constituents. Season 1935-1936.

	Common Sunnhemp.	Somerset Sunnhemp.	Somerset Velvet Beans.	Biltan Soya Beans.	Maize cut for Silage.	Wintersome cut for Silage.
Pounds of Green fodder...	11,392	13,584	26,816	10,560	31,496	39,088
	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.
Moisture...	77.8	81.2	78.48	72.67	75.95	80.27
Ash	1.6	1.6	1.6	1.85	1.14	1.01
Crude Protein ..	3.4	3.2	3.24	3.97	.94	.93
Ether Extract ..	.3	.3	.37	.60	.33	.18
Fibre	9.3	7.1	6.23	7.91	5.09	5.86
Carbohydrates .	7.6	6.6	10.08	13.00	16.55	11.75
	lbs. per acre.	lbs. per acre.	lbs. per acre.	lbs. per acre.	lbs. per acre.	lbs. per acre.
Dry matter... ...	2,529	2,554	5,771	2,886	7,575	7,712
Crude Protein ..	387	435	869	419	296	364
Nutritive Ratio	1:5.2	1:4.5	1:5.3	1:5.6	1:23.8	1:19.4

These figures reveal in a very striking manner that there are great differences in the protein-production power of our

common fodder crops. Comparison of the heaviest crop of cereal fodder with the lightest crop of legume fodder shows that the crop of nearly twenty tons of wintersome contained less protein than the five and a quarter tons of Biltan soya bean fodder. Sunnhemp also is shown to be a more efficient protein producer than either maize or wintersome, but the velvet beans yielded twice as much protein as either of the other legumes, and nearly three times as much as the maize.

These trials were repeated again during the season under review but the common variety of sunnhemp was omitted, and it was thought that, instead of making a chemical analysis of the green fodder it would be more satisfactory if an analysis was made of the fodders after curing, because they would be used in that state in farm practice. The crops were all sown on 3rd December and were all cut when they had reached that stage of their growth at which it is usual to reap them, when they are to be used for fodder purposes. They were stacked until the following September, when samples were drawn and submitted to the Chemical Branch for analysis. It was decided that a determination of the protein content only, would supply the information required in this instance.

Yields of Cured Fodder and Protein in lbs. per Acre.
Season 1936-37.

	Somerset Sunnhemp.	Somerset Velvet Beans.	Biltan Soya Beans.	Maize.	Wintersome.
Date of Cutting.	March 1st	April 8th	April 1st	April 1st	April 1st
Weight of hay	4,001	5,320	3,501	6,921	9,760
Moisture per cent.	5.92	6.63	7.23	6.27	6.01
Dry matter per acre ...	3,764	4,967	3,248	6,487	9,173
Protein in 100% dry matter	7.17	9.43	9.57	2.73	2.72
Protein in lbs. per acre ...	270	468	311	177	249

The results of the second season's trials are seen to confirm those of the first season. The yields of protein of all the various crops were somewhat lighter than those of the previous season, although in some cases the yields of dry matter were heavier. Their relative positions as protein producers remains about the same, but the velvet beans have not maintained the pronounced lead which the first season's results indicated. Further, although the figures given reflect fairly accurately the relative value of the velvet beans when the crop is utilised as silage, it should be remembered that the yields would probably be somewhat less in farm practice, when the crop is utilised as hay, because a proportion of the large fleshy pods become detached from the vines during the processes of handling the material and will be lost, unless special measures are taken to recover them. The pods which are included with the vines and leaves retard the curing of the hay and may be a cause of much of it becoming spoiled. If the crop is reaped before the pods are large enough to interfere with curing the hay, there will be a corresponding loss of weight. This reduction may amount to 25% or even more, and if that amount is deducted from the weights given above it will be seen that it brings the velvet bean down to the level of the other leguminous crops when it is employed for the production of hay. Comparison of the chemical analyses of the various crops indicates that the fodder of the soya beans is the highest in quality, and this is corroborated by farmers who have fed the hay, and found it to be most palatable and nutritious to all classes of farm stock. The three legumes in these trials each have merits and demerits peculiar to themselves. Sunnhemp requires a much shorter season than the others and can be sown a month later than they, without reducing the crop, but it requires seeding heavily, and much of the leafy portion may be lost if unfavourable weather conditions prevail during the haymaking period.

Velvet beans are very hardy and their seed is cheap, but unless they are used as silage the grower has to be content with a reduced crop, or run the risk of losing part of it through delayed curing due to the presence of numerous fleshy seed pods. The Biltan soya beans yield hay of the highest quality and palatability; they can be seeded at moderate cost, cured and fed with less risk of loss of material and outlay for labour

than the velvet beans, but they are not quite as hardy during the seedling stages and appear to require somewhat more fertile soil than the other legumes.

It may be mentioned here that farmers who wish to grow soya beans for hay should be careful to sow a suitable variety. The best hay types we have at present are known as Biltan and Otoxi. The brown coloured seed of the latter variety is suitable for human consumption, although for this purpose the yellow-seeded kinds are preferred, but as their habit of growth is dwarf and bushy, their yield of fodder is considerably less than that of the hay types, and for this reason they should be eschewed when hay production is the objective.

The results of these trials show that the legumes produced approximately twice as much protein per acre as the cereals in half the bulk of material, and they show that when crops are grown with a view to the provision of food for livestock these legumes will prove more economical than the cereals. It should be borne in mind, also, that the stubble of the legumes makes an important contribution to the fertility of the soil.

Effect of Grass Mulch on the Yield of Maize.—It is well known that crop yields are largely influenced by the incidence of the rainfall, as well as by the quantity of water which falls, and that a proportion of the precipitation is not effective because, during heavy storms, much water runs off the surface instead of soaking into the soil, and also that much of the soil water is lost through evaporation. On some farms there is an abundance of long grass which could be used to cover the surface of the soil to form a mulch, for such a protective covering serves a number of purposes:—

(1) It conserves moisture by preventing evaporation.
(2) It protects the surface of the soil from extreme climatic conditions.
(3) It keeps the soil temperature more even and the surface loose and friable.
(4) It adds vegetable matter containing plant foods to the soil.
(5) It encourages soil organisms.
(6) It protects the soil from surface erosion.

Experiments were commenced in the season 1934-35 to investigate the effect on the yield of maize grain and sunflower seed of covering the surface of the soil with dry grass at the rate of two tons per acre. A block of land an acre in extent was divided into eight pairs of plots, and one plot of each pair has been mulched each season, while the other has received no grass covering, but in all other respects the plots have been treated in exactly the same manner. In the season before this experiment began, the whole area received a dressing of farm-yard manure at the rate of 15 tons per acre, and in the season 1936-37 superphosphate at the rate of 200 lbs. per acre was applied. Each year, half of the plots are sown to maize and the other half to sunflowers; the plots which carry maize one year are sown to sunflowers in the following season and *vice versa*. Cultural operations connected with the weeding of the crop make it necessary to delay the application of the grass mulch until the latter part of the month of January.

In the following tabulation the average yields of each group of the plots which were treated alike are shown.

Yields of Maize Grain in lbs. per Acre.

	Mulched.	Not Mulched.	Increase due to mulching. lbs.	%
Season 1934-35 ...	2,404	1,792	612	34
,, 1935-36 ...	4,664	4,060	604	15
,, 1936-37 ...	4,064	3,492	572	16

Yields of Sunflower Seed in lbs. per Acre.

	Mulched.	Not Mulched.	Increase due to mulching. lbs.	%
Season 1934-35 ...	1,676	1,608	68	4
,, 1935-36 ...	1,236	1,080	156	14
,, 1936-37 ...	1,612	1,248	364	29

These results show that the mulching has had a definite beneficial effect. In the case of the maize an increase of three bags per acre has been obtained each season. The sunflowers show similar increases with the exception of the first season. It appears that farmers who have a plentiful supply of grass which is easy to collect, could employ this method to augment

their maize yields, but whether or not it will prove economical, depends entirely on the costs involved for the operations connected with cutting, transporting and spreading the grass, and the interference of the grass covering with the control of witchweed by hand and animal cultivation.

Field observations during the autumn months showed that the plants on the mulched plots retained their green colour longer than those on the untreated plots, and when the land was ploughed, the soil on the mulched plots was found to be more friable than that of the control plots.

Millet Variety Trials.—In July, 1934 three varieties of millet classified as "White," "Yellow" and "Red" were received through the courtesy of the Rhodesian Milling Company, and a parcel of "Extra Super" canary seed (*Phalaris canariensis*). It was reported that these seeds were in demand on the English markets at very high values and that they were largely used for cage birds. In the following season they were included in trials with Boer manna and Proso millet. Droughty weather prevailed and the new millets proved less hardy than the older varieties. The canary seed succumbed before any seed formed. The "Red" variety of millet was found to be mixed with other kinds, and as it did not thrive very well, it was excluded from subsequent trials.

During the three seasons 1935-38, date-of-planting trials were carried out. The trials were vitiated by drought in the second season, but those of the first and third seasons provided useful information.

In the tabulation below the dates of sowing and the approximate dates of reaping the corresponding crops are given. The figures represent the averages of the three seasons' trials.

Millets: Dates of Sowing and Reaping.

Date of Sowing.	Date of Reaping. White Millet.	Yellow Millet.	Proso Millet.	Boer Manna.
Dec. 1st	Feb. 10th	Feb. 11th	March 1st	March 16th
Dec. 23rd	Feb. 28th	Feb. 28th	March 25th	April 12th
Jan. 12th	March 11th	March 13th	April 1st	April 19th
Feb. 2nd	April 5th	April 5th	April 19th	May 28th
Average number of days	67	68	87	111

Yields of Grain in lbs. per Acre.

Date of Sowing.	White Millet.	Yellow Millet.	Proso Millet.	Boer Manna.
Season 1935-36—				
December 15th ...	825	1,072	1,733	3,250
January 7th... ...	734	693	1,246	1,691
January 30th ...	190	Failed	972	825
February 20th ...	Failed	Failed	512	1,056
Season 1937-38—				
December 2nd ...	1,133	800	1,500	1,817
December 23rd ...	417	375	1,133	1,160
January 12th ...	150	75	742	884
February 2nd ...	183	125	783	Failed

The best crops of grain have been obtained from the earliest plantings, but owing to the short period required by the new millets to reach maturity, the early sown crops are ready for reaping during February, at which time, rainy weather may be expected, and the risk of losing the crop from that cause would be incurred. The later plantings were attacked by a leaf disease which reduced the yield considerably. The new kinds appear to be more delicate than the older varieties. Besides being attacked by the leaf disease mentioned, while the other kinds are almost immune to it, they also appear to be more severely affected by droughty conditions when such are encountered.

The new varieties require but a short period to reach maturity, and it might be possible to sow them under irrigation in the early spring months and to reap the mature grain before the commencement of the seasonal rains. Their seed is valued at nearly double the price of the seed of the Proso variety, owing to its plump appearance, large size and clear glazed skin, so that, although their yields may be somewhat lighter than those of the other kinds, they would prove more remunerative to grow if yields as high as the best recorded above could be ensured.

Pyrethrum.—Trials with this crop have been conducted for some six seasons. The first plantings produced a large proportion of barren plants when they were grown under dry land conditions, but higher yields were obtained when the

crop was grown under irrigation. By using seed from the very few plants which produced a large quantity of flowers, strains have now been established which are more productive than the original kinds. Although the yields obtained under dry land conditions are still rather lower than are required for economical production, that obtained from an irrigated plot this season, *viz.*, 1,296 lbs. of dried flowers per acre, indicates that returns comparable with those obtained in other countries where it is grown on a commercial scale, could be obtained in those parts of this Colony at a suitable elevation above sea-level where facilities for irrigating the crop are found. In Kenya Colony the best crops are grown at high altitudes. This suggests that land in the mountainous districts along the Eastern border where water is available for irrigation or the rainfall extends over a longer period than it does at this Station, might produce highly remunerative crops of pyrethrum.

Rhodesia Weather Bureau.

JULY, 1938.

Pressure.—Mean barometric pressure for the month was slightly below normal.

Temperatures.—Cloud amount was well above the average and this resulted in maximum temperatures being below the average, while minimum temperatures were above. Mean temperatures varied from 1° above normal at Sinoia to 1.3° below at Gwanda and Enkeldoorn.

Rainfall.—Maritime air masses predominated the circulation and light isolated showers fell in various parts of the country. Southerly highs and the "guti" weather associated with them were rare, and the rainfall in the east and south was therefore deficient.

PRECIPITATION.

Station.	Inches.	Normal.	No. of Days.
Beitbridge...	0.01	0.18	1
Bindura	0.00	0.03	—
Bulawayo	0.00	0.05	—
Chipinga	0.08	0.60	2
Enkeldoorn	0.00	0.08	—
Fort Victoria	0.00	0.10	—
Gwaai Siding	0.00	0.00	—
Gwanda		0.07	
Gwelo	0.00	0.02	—
Hartley...	0.00	0.01	—
Inyanga	0.00	0.11	—
Marandellas	0.00	0.07	—
Miami	0.00	0.06	—
Mount Darwin		0.01	
Mount Nuza	0.26	1.23	4
Mtoko	0.00	0.02	—
New Year's Gift...	0.03	0.27	1

Station.	Inches.	Normal.	No. of Days.
Nuanetsi...	0.00	0.23	—
Plumtree	0.00	0.05	—
Que Que	0.07	0.02	1
Rusape	0.00	0.17	—
Salisbury	0.02	0.02	1
Shabani...	0.00	0.04	—
Sinoia	0.05	0.03	1
Sipolilo	0.00	0.02	—
Stapleford	0.24	1.07	1
Umtali	0.00	0.30	—
Victoria Falls...	0.00	0.00	—
Wankie	0.00	0.00	—
Abercorn	0.00	—	—
Balovale	0.00	—	—
Broken Hill	0.00	—	—
Fort Jameson...	0.00	—	—
Fort Roseberry	0.00	—	—
Kanchindu	0.00	—	—
Kapiri Mposhi	0.00	—	—
Kasama	0.00	—	—
Kasempa	0.00	—	—
Livingstone...	0.00	—	—
Lusaka	0.00	—	—
Mankoya	0.00	—	—
Mazabuka	0.00	—	—
Mkushi	0.00	—	—
Mongu	0.00	—	—
Mpika	0.00	—	—
Mporokoso	0.00	—	—
Mufilira	0.00	—	—
Namwala	0.00	—	—
Ndola	0.00	—	—
Petauke	0.00	—	—
Senanga	0.00	—	—
Shiwa Ngandu	0.00	—	—
Solwezi...	0.00	—	—

JULY, 1938

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	8-30 a.m. Wet Bulb.	8-30 a.m. Dew Point	8-30 a.m. Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Beitbridge...	1,500	58.0	51.6	46	6.0	76.6	46.5	61.6	87	27	37	27	1	...	...	4	61.7	971.1	886.6	969.1	2.8	...
Bindura...	3,700	55.5	49.8	44	5.0	73.0	45.3	59.2	81	28	38	16	...	2	..	5	58.2	896.5	886.1	...	2.1	...
Bulawayo	4,393	54.5	47.1	39	6.4	69.2	44.5	56.9	77	28	33	9	...	21	...	3	56.3	874.1	885.9	872.7	2.5	9.6
Chipinga	3,685	59.3	51.9	45	7.0	68.5	49.2	58.8	78	27	45	9	...	21	...	...	57.4	897.7	886.8	...	4.4	...
Enkeldoorn	4,788	54.0	47.6	41	5.5	67.6	43.6	55.6	77	28	37	14	...	20	...	8	55.1	861.5	886.0	...	3.5	...
Fort Victoria... ...	3,571	55.9	49.3	43	5.8	70.5	42.5	56.5	81	7	34	16	...	13	..	14	57.4	900.8	886.2	899.4	3.5	...
Gwaai Siding... ...	3,278	51.6	45.5	39	5.0	77.4	38.6	58.0	85	28	26	9	...	...	...	19	...	909.7	885.4	...	1.7	...
Gwanda...	3,233	55.9	48.3	40	6.6	71.3	43.9	57.6	80	27	37	17	...	10	...	8	58.4	912.0	886.1	...	1.5	...
Gwelo	4,629	53.8	47.3	40	5.5	68.2	43.4	55.8	75	27	35	9	...	19	...	4	55.1	866.6	886.0	...	2.8	...
Hartley...	3,879	55.7	48.7	42	6.1	73.1	44.0	58.5	80	28	34	9	...	3	...	8	58.7	890.2	885.5	...	2.5	...
Inyanga...	5,503	56.1	47.6	39	7.4	66.6	43.1	54.9	72	8	33	12	...	23	...	6	53.4	...	...	...	2.9	...
Marandellas	5,453	52.7	47.2	42	4.7	65.7	44.4	55.0	73	29	39	16	...	26	...	3	53.2	...	...	...	3.0	...
Miami	4,090	58.9	52.2	46	6.4	72.0	45.4	58.7	78	28	39	18	...	8	...	1	57.8	882.6	884.6	881.2	2.1	...
Mt. Darwin	3,179	59.5	53.1	47	6.1	74.2	45.3	59.7	82	28	37	16	...	3	...	7	60.6	...	...	...	2.9	...
Mount Nuza	6,668	45.6	42.9	40	2.1	54.6	41.5	48.1	65	27	37	15	...	31	...	8	46.0	804.2	886.4	...	5.5	...
Mtoko	4,141	57.3	50.5	45	6.2	67.4	48.5	57.9	75	28	42	15	...	23	...	...	57.7	882.2	885.8	881.0	2.5	..
New Year's Gift...	2,690	57.1	51.8	47	4.9	73.5	46.3	59.9	83	28	36	9	...	2	...	1	...	...	...	...	...	7.2
Nuanetsi	1,581	58.7	51.9	46	6.3	76.7	43.2	59.7	87	27	35	13	1	...	...	8	...	968.9	886.7	...	3.0	...

JULY, 1938 (continued)

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	Wet Bulb.	Dew Point	Vapour Press Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Plumtree	4,549	55.6	46.7	37	7.8	68.9	46.3	57.6	76	28	39	9	...	17	...	1	56.4	...	...	...	0.6	...
Que Que	3,999	55.6	48.6	41	6.1	72.8	44.9	58.9	81	28	38	18	...	4	...	4	58.9	886.5	885.7	884.9	2.2	...
Rusape	4,648	53.6	48.5	43	4.4	67.3	41.5	54.4	76	27	34	15	...	21	..	12	54.2			...	2.5	...
Salisbury	4,831	55.5	48.5	42	6.1	69.5	43.6	56.6	77	28	35	17	...	19	...	5	56.1	860.2	885.6	859.0	3.1	7.8
Shabani	3,131	57.8	49.8	42	7.2	72.3	46.1	59.2	83	28	39	16	...	9	...	1	59.2	...	...	...	3.3	...
Sinoia	3,795	56.1	50.0	45	5.5	74.8	41.5	58.2	81	28	33	17	...	...	...	12	57.2	...	...	...	2.7	...
Sipolilo	3,876	59.6	51.7	45	7.4	72.1	46.7	59.4	80	28	39	9	...	7	...	1	...	...	...	...	1.6	...
Stapleford	5,304	49.3	46.8	44	2.1	60.1	37.5	48.8	71	28	28	12	...	30	...	19	47.9	...	...	...	5.3	...
Umtali	3,672	57.2	52.3	48	4.6	70.6	47.9	59.3	80	28	42	15	...	16	...	...	58.1	898.1	886.8	896.7	3.5	...
Victoria Falls... ...	3,009	58.3	49.4	39	7.0	80.1	43.8	62.0	88	30	35	9	5	...	...	7	...	...	...	...	1.0	...
Wankie...	2,569	59.7	49.9	40	9.0	80.9	53.8	67.4	90	28	45	9	5	1	...	...	67.2	932.6	885.0	...	0.5	...
Abercorn	5,407	60.2	54.7	51	5.4	74.4	51.9	63.1	80	17	49	20	...	..	...	...	...	839.3	882.8	...	0.3	...
Broken Hill	3,920	57.6	50.8	45	6.2	74.1	49.3	61.7	80	7	41	16	...	...	...	...	...	887.6	883.8	...	2.0	...
Chipili	...	...	...	...	...	...	...	...	...		...		...	...	...	...	...	...	...	...	...	...
Fort Jameson ...	3,620	63.9	56.7	51	7.5	80.1	54.3	67.2	85	9	50	17	...	...	...	...	...	891.3	884.9	...	1.1	...
Kasama...	4,700	60.1	54.7	50	5.3	77.1	50.4	63.7	80	8	46	15	...	...	...	...	...	866.6	883.5	...	...	...
Kasempa	4,500	54.0	49.5	45	4.0	75.0	38.5	56.7	80	6	27	10	...	...	...	14	...	..	...	...	...	...
Livingstone	3,140	53.2	46.5	39	5.8	77.3	45.2	61.3	86	6	37	9	1	...	...	2	60.7	916.1	884.5	...	1.7	...
Lusaka	4,193	59.1	51.5	44	7.2	72.7	49.8	61.2	79	28	44	18	...	6	...	...	...	878.7	884.1	...	2.5	...
Mazabuka Res. ...	3,385	59.8	52.3	45	7.1	76.6	52.7	64.7	83	7	43	10	...	...	...	..	...	904.3	884.1	...	1.4	...
Mongu	3,475	57.9	50.2	43	7.0	83.0	49.6	66.3	89	31	37	9	8	...	...	2	...	901.0	883.3	...	0.6	...
Mpika	4,625	59.0	53.2	48	5.5	72.1	48.7	60 4	77	10	38	19	...	8	...	1	...	865.2	884.1	...	1.7	...
Mwinilunga	4,450	52.5	49.1	49	2.9	77.4	42.2	59.8	82	20	38	11	...	...	...	3	...	...	...	...	...	...
Ndola	4,140	57.6	51.8	47	5.4	76.5	48.4	62.4	82	30	41	12	...	...	...	...	...	878.5	883.5	...	1.5	...

Southern Rhodesia Veterinary Report.

JUNE, 1938.

DISEASES.

Anthrax was diagnosed in the Mtoko Native Reserve, Mtoko Native District, and on farm Liberty, Victoria Native District. Mortality five head of cattle.

Foot and Mouth Disease was diagnosed on Devuli Ranch "C" Section, Bikita Native District, involving approximately 4,000 head of cattle.

TUBERCULIN TEST.

Forty cows were tested upon importation, of which eight gave a positive reaction to the test.

MALLEIN TEST.

Twenty-five horses and 12 mules were tested upon entry. No reactions.

IMPORTATIONS.

From Union of South Africa.—Cows 40, horses 25, mules 12, sheep 212.

From Bechuanaland Protectorate.—Sheep 1,051.

EXPORTATIONS.

To Union of South Africa.—Oxen 86.

To Northern Rhodesia.—Sheep 42, goats 2.

To Portuguese East Africa.—Cows 21, oxen 23.

To Congo Belge.—Mules 19, pigs 3.

To Nyasaland.—Pigs 5.

EXPORTATIONS.—MISCELLANEOUS.

To United Kingdom.—Chilled beef quarters, 8,075; frozen boned beef quarters, 1,204; kidneys, 93 lbs.; tongues, 74 lbs.; livers, 429 lbs.; hearts, 77 lbs.; tails, 80 lbs.; skirts, 39 lbs.; shanks, 32 lbs.

To Congo Belge (in cold storage).—Beef carcases, 598½; mutton carcases, 36; veal carcases, 51.

Meat Products, from Liebig's Factory:—

To Union of South Africa.—Corned beef, 75,404 lbs.; beef fat, 4,800 lbs.

To United Kingdom.—Meat extract, 25,026 lbs.; beef powder, 45,977½ lbs.

B. A. Myhill,
Acting Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-38.

Monthly Report No. 68. July, 1938.

Winged swarms of the Red Locust (*Nomadacris septemfasciata*, Servi.) have been reported in various districts in the northern part of the Colony during July, namely, Lomagundi, Mazoe, Mrewa, Salisbury and Hartley, and one report refers to Wankie in the extreme west.

The size of the swarms varies from "small" to "large." One swarm which remained in the neighbourhood of Salisbury from 8th to 12th, was observed to occupy about three hours to pass over. The reports fail to indicate any general trend of direction of flight.

No damage has been reported.

RUPERT W. JCAK,
Chief Entomologist.

THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.
(Assisted by the Staff of the Agricultural Department).

PUBLISHED MONTHLY.

Subscription: 5/- per annum; payable to the Accountant, Department of Agriculture, Salisbury.

VOL. XXXV.] OCTOBER, 1938. [No. 10

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Time to Clean Tobacco Lands.—Because weeds are appearing, and may become a source of infestation by various tobacco pests, including leaf eating insects, whitefly and aphis, control measures against weeds should be undertaken now, not only in the lands, but also on a strip around the lands. "Cleanliness Aids Insect Control."

Citrus from the Union of South Africa.—As the Union Department of Agriculture and Forestry is now satisfied that citrus canker has been eradicated, and has withdrawn all internal citrus canker restrictions on the movement of citrus, it is considered that the danger of introducing the disease from the Union into Rhodesia has now passed.

Accordingly, the special restrictions on the introduction from the Union of South Africa of citrus trees, budwood, seeds, and other parts for propagation, and citrus fruit, have been withdrawn. Permits are still necessary for the introduction of parts for propagation (except seed), but fruit may be brought in without permit, although it is subject to inspection.

The Union Government is to be congratulated on the success of its anti-citrus canker campaign.

A New Chapter in Soil Fertility?—Developments of the first importance in agriculture may follow from research work approaching completion in the laboratories of the Botany Department, Queen Mary College, London. Scientists have long been aware of the fact that Indian rice crops, despite the absence of any system of manuring, continue year after year without loss of quality. It was thought possible that, during the flooding of the rice fields, the under-water plant life (*algæ*) may have acted as a natural fertilising agent. Mr. P. K. De, sent to England by the Imperial Agricultural Research Council of India, has been working under the direction of Professor F. E. Fritsch, F.R.S., at Queen Mary College, where it has been conclusively proved that certain of the blue-green *algæ* occurring in the water have the power to absorb nitrogen from the atmosphere, and thus after decay to enrich the soil and in turn to feed the rice crops. "As a result of this discovery," states Professor Fritsch, "it may be possible, with a little successful manuring, greatly to enhance the nitrogen-absorbing capacity of these algæ and thus to improve the rice crop. Now we know for certain the hitherto mysterious source from which the rice crops draw their strength. It is possible that further research will open a new chapter in soil fertility."

This achievement follows a two-years' investigation and many disappointments. To prove without doubt that the *alga* itself was absorbing nitrogen, it was first necessary to secure specimens of blue-green algæ completely free from bacteria. After ten months' work, six different specimens were secured

entirely separate from any other growth, and it was then established beyond doubt that this low form of plant life does in fact take in nitrogen and is thus a natural manuring agent. The economic importance of this discovery lies in the fact that further research may show how this new knowledge can be extended to agricultural production, not only in India, but elsewhere.—(*The Fertiliser, Feeding Stuffs and Farm Supplies Journal.*)

1938 Winter Wheat Crop.—According to a recent issue of the Economic and Statistical Bulletin the preliminary estimate of the 1938 wheat crop is 42,126 bags, or nearly a thousand bags less than the 1937 winter crop. The estimated number of growers is 120 less than last year.

Charter remains the most important wheat growing district. In 1937 of a total of 21,946 acres planted to wheat in the Colony 6,372 acres (comprising 5,118 acres of vlei and 1,254 acres of irrigated lands) were planted in the Charter district, where the yield was 11,254 bags, or over a quarter of the total production. Although the area planted to wheat in the Gutu district showed an increase of over 1,000 acres between 1936 and 1937, production declined by some 800 bags. The other principal wheat areas in order of relative importance in 1937 were Chilimanzi, Mazoe, Salisbury, Victoria-Ndanga and Melsetter. Almost the entire crop of wheat in the Mazoe district, about 1,100 acres, is grown under irrigation.

Insects of Citrus and Other Sub-tropical Fruits, by Henry J. Quayle, Comstock Publishing Co., Inc., Ithaca, N.Y., 1938; pp. xiii.+583, with 377 illustrations, 8vo., cloth, $5.00.

For thirty years Professor Quayle has studied the subject embraced by the title of his book, mainly in California, but with three years' experience in various parts of the world, including South Africa and Rhodesia. He visited Southern Africa in 1930, and as a result mentions Mr. C. P. Lounsbury, late Chief, Division of Entomology, Pretoria; Dr. T. J.

Naude, present Chief Entomologist, Pretoria; and Dr. W. J. Hall, Director of the B.S.A. Company's Citrus Experimental Station at Mazoe, which names head the list of two dozen specialists outside of the United States, to whom he expresses especial gratitude for co-operation.

The publication is a typical text-book, with a profusion of information, especially on insects and mites of citrus, of which the discussion occupies more than half the book. The mango, although grown to some extent in Southern Rhodesia's sub-tropical climate, is more of a tropical fruit and is not included, but pests of avocado, pecan, olive, oriental persimmon and half-a-dozen other fruits are dealt with.

The book is well illustrated, some illustrations being of a rather technical nature, but the great majority of them are of interest to the average sub-tropical fruit grower. Their reproduction is of high quality. The subject matter is clear and simply stated with only a few technical interludes.

For the sake of convenient treatment and reference the author classifies the citrus pests into major and minor groups, the major group including those insects and mites that are most likely to necessitate the adoption of control measures against them. But this classification, he points out, may vary with the climate and other factors, the same insects being differently arranged in this classification in different localities. As well as climate, some important factors that may have a bearing on both the absolute and comparative status of a pest are food plants, the stage of development of the fruit-growing industry concerned, and commerce. If the industry is young, serious pests may be present, although not recognised as such —they may take as long as fifty years to reach their maximum. Again, *commerce may introduce new pests.*

(Although it is believed that practically all insect pests will eventually become cosmopolitan, limited by climatic conditions, Southern Rhodesia is apparently in a good position at present as regards introduced insect pests in general, and to delay the evil day as long as possible a good plant inspection service is necessary, as is the co-operation of the public.)

Besides insects and mites, Professor Quayle discusses certain rodents, nematodes and snails. An enlightening chapter on spraying and dusting is included, and one on fumigation. Apart from these chapters, control measures, when applicable to only one species are given with the discussion of the species concerned, or they may follow the discussion of a group of similar pests such as the aphids. More important control measures, as against scale insects, are included in the chapters on spraying, dusting and fumigation.

In respect of formulae given for chemical control, the author has slipped from the pillar of accuracy on which he perches, at least from the point of view of the British reader. The omission of the explanatory initials "U.S." after the words "gallons," "quarts" and "pints" may lead to the application of over-diluted sprays which, while fortunately it would not result in injury to trees, may cause waste of spray, time and labour to those who do not notice the omission. The measure, 1 gall. (U.S.), 1 qt. (U.S.), and 1 pt. (U.S.) are equivalent to 5/6 gal. (Imp.), 5/6 qt. (Imp.) and 5/6 pt. (Imp.) respectively. However, there are not many formulae given in which weights and these measures of capacity both occur, but the omission should be noted by local readers.

A final chapter gives details of the United States' domestic legislation controlling the movement of plants, etc., in order that only clean plants may enter various localities. Regarded in this light, the legislation is a good example of one of the many applications of our local slogan, "Cleanliness Aids Insect Control."

M.C.M.

The Spraying of Tobacco Seed Beds and Control of Rosette Disease.

By J. C. F. HOPKINS, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist, and

M. C. MOSSOP, M.Sc., Entomologist.

The newly recognised virus disease of tobacco, which was briefly described by Wickens([1]) in the March, 1938, issue of this *Journal*, has claimed the attention of both the Agricultural Department and the growers during the past season. The disease, which Wickens proposes to call **tobacco rosette,** has become widely distributed in the Colony in the last twelve months, and is now of common occurrence in most of our tobacco areas. As far as can be gathered from reports received from growers, the disease has spread through Lomagundi and Mazoe districts, and parts of Marandellas, but does not appear to have penerated as far as Inyazura and the Makoni district generally, although heavy infestations of aphis have occurred in the last-named area. The transmission of rosette from healthy to diseased plants by the aphis or greenfly, *Myzus persicae*, Sulz., has now been demonstrated beyond all doubt by Wickens at Trelawney, K. M. Smith* at Cambridge, England, and Hopkins† at Salisbury.

The absence of the disease in crops heavily infested with aphis suggests that it may have originated from some central focus of infection and spread rapidly outwards, rather than that sources of infection occur naturally in the Colony. This fact raises a hope that further spread may be arrested, and it is with this object in view that tobacco growers are asked to carry out to the best of their ability the recommendations made in this article.

*Private communication.

†Unpublished.

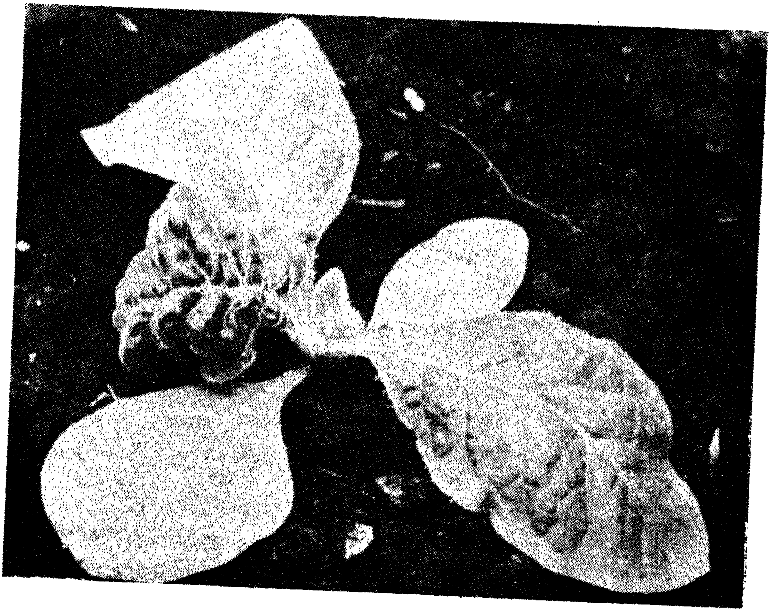


Fig. 1.—Symptoms of Rosette in tobacco seedling.

Fig. 2.—Mixed infection by Rosette and Mosaic in half-grown plant.

Most tobacco growers are familiar with the virus disease known as leaf-curl, which is carried from diseased to healthy plants by means of whiteflies. It is also known that certain wild plants are susceptible to the leaf-curl virus and act as reservoirs of infection to tide the disease over from one season to the next. The practical significance of this, fortunately, is not of great importance with this particular disease in Rhodesia, so that the punctilious removal and destruction of all growing tobacco during a "close season" has resulted in the virtual disappearance of leaf-curl from the tobacco crop.

Now, rosette disease is similar to leaf-curl in many respects. It is due to a virus, is spread by an insect, and can also infect wild veld plants. But two important distinctions between these diseases are known to exist, even with our present very meagre knowledge of rosette. They are (1) aphids have been shown to be much more efficient carriers of rosette than whiteflies are of leaf-curl and (2) aphids multiply at a much greater rate than whiteflies. It therefore appears that more attention must be given to the destruction of the known alternate host plants of the rosette virus than has been the case wih those of the leaf-curl virus, and every effort should be made to keep aphids under strict control.

Aphis.—A few aphids seen or suspected in the seed-beds do not appear at first sight to be a serious matter. But when one considers the enormous capacity for increase which aphids possess one will understand the potential danger of the presence of even one female. One of the classic computations demonstrating the astonishing fecundity of aphids is that in which it was shown that the uninterrupted breeding of ten generations from an individual female ancestor would produce organic matter equal in mass to 500,000,000 humans. Obviously this cannot occur or the mass would exceed that of the earth in a very few years. But it does demonstrate the need for continued efforts against aphis if any reasonable benefit is to be derived from control measures. Factors contributing to the fecundity of aphids are: birth from virgin females, frequent production of young instead of eggs, and early age at which reproduction is possible.. These factors all assist in hastening the production of new generations.

Factors helping to prevent enormous accumulations of aphids include food plants, climate, weather, enemies and disease. A further factor can be added where cultivated crops are concerned, namely, artificial control. The basis of a good economical spray or dust to use against aphids is tobacco. In the form of spray on tobacco seed-beds, nicotine sulphate and not home-made tobacco wash should be used, as the latter when used with Bordeaux releases the copper in the mixture and burning of the foliage results.

Spray should be applied with high pressure through a nozzle giving a very fine mist. Every reasonable effort should be made to wet the whole surface of each seedling. Admittedly perfection is more or less unattainable, but this is all the more reason for being as thorough as possible. The pressure behind a misty spray causes local eddies that assist in wetting the greater part of each plant. Where a suitable opening in the dense foliage can be found or made, the nozzle should be poked amongst the seedlings so that the spray may reach the under sides of the leaves more directly. Aphids that are not hit by the spray will not be killed by it. Owing to the rapid breeding of aphids, one or two applications of nicotine are insufficient, and it is, therefore, necessary to add nicotine sulphate to the Bordeaux mixture that is normally applied every five days.

The inclusion of nicotine sulphate in the spray also assists in keeping down the tobacco whitefly (*Bemisia rhodesiaensis*, Corb.), the vector of leaf-curl, but here again it is most important that the under sides of the leaves are reached.

In addition to nicotine sulphate and Bordeaux mixture, lead arsenate should be included in the spray. This insecticide reduces attack by split worm, leaf miner, leaf-eating insects, and to some extent cutworm. Split worm and leaf miner caterpillars are controlled by applications of lead arsenate only before the insects have burrowed into the plants. Once inside, they feed on the inner tissues and are no longer vulnerable to poison deposits that are confined to the surface.

Rosette Disease.—The symptoms of tobacco rosette in the field have been described by Wickens[1] and most growers are now familiar with the disease.

That it can occur in seed-beds does not, however, appear to be so well known, but it has been observed on several occasions in the Lomagundi district.

The first symptom on young seedlings is a slight curling downwards of the tip of one of the youngest leaves just emerged from the bud. The plant continues to grow and the affected leaf begins to pucker up as shown in Fig. 1. Subsequent leaves grow in the same way, the distortion becomes more accentuated, and eventually a rosette of twisted and puckered leaves forms in the crown of the plant and growth is arrested.

Where infected aphids have gained access to seed-beds and have fed upon the seedlings, a number of these diseased plants will be observed. This is particularly the case in early beds from which plants have been pulled for setting out in the lands, the remainder having been left for supplies.

Apart from following the spraying recommendations, growers are urged to be particularly vigilant this season in seeking out seedlings infected with rosette. Diseased plants should be pulled out at once and buried deeply or burned, so as to destroy not only the affected plant, but also any aphids with which it may be infested. For it must be remembered that any greenflies escaping from an infected plant and invading a seed-bed will without doubt infect a good number of healthy seedlings. It will not be out of place to emphasise once again the fact that the aphis, *Myzus persicae*, is known to be an extremely efficient carrier of rosette.

With this in mind, it is necessary to consider the question of alternate host plants, including susceptible weeds.

There is reason to believe* that a number of plants may harbour the rosette virus and are fed upon by the greenfly carrier. They are tomato, zinnia, potato, the small nightshade or Sobee (*Solanum nigrum*) and the Chinese lantern plant or false Cape gooseberry (*Nicandra physaloides*). Tomatoes, zinnias and potatoes are common garden plants, the first two often being grown near to seed-bed sites. Sobee and false gooseberry are usually to be found growing in vleis or

*Private communication from Dr. K. M. Smith.

on organic matter near seed-beds, and the latter can always be found in abundance near to cattle kraals. It is of utmost importance that these weeds should be kept down on all parts of tobacco farms and that tomatoes, potatoes and zinnias be grown as far as possible from tobacco seed-beds and lands.

In urging the eradication of over-wintering host plants, sight must not be lost of the most obvious and dangerous of all, namely, ratoon tobacco. Thorough cleaning of lands and the continual removal of re-growth is now of greater importance than ever, for one dirty land may spell disaster not only for the owner, but also for his neighbours.

Recommendations for Control.—Recommendations for the control to tobacco rosette may be summarised as follows:—

1. Meticulous exclusion from fallow lands of all tobacco re-growth.

2. Removal from seed-beds and destruction of all seedlings showing symptoms of the disease.

3. Eradication of weeds, in particular false gooseberry and small nightshade or Sobee, from seed-bed sites.

4. Cessation of tomato, potato and zinnia culture in the neighbourhood of tobacco lands and seed-beds.

5. Control of aphis by spraying every five days with Bordeaux, arsenate of lead and nicotine mixture according to the following fomula:—

Bordeaux	8 lb.
Arsenate of lead...	$1\frac{1}{2}$ lb.
Nicotine extract (40%)	16 fluid ozs.
Spreader	According to manufacturers' directions.
Water	50 gallons.

6. The destruction of all residual plants as soon as each bed is finished with.

REFERENCE.

(1) Wickens, G. M. (1938).—"A New and Serious Disease of Tobacco in Southern Rhodesia." *Rhod. Agric. Journ.*, XXXV. 3, p. 181.

Deferred Grazing

SEEDS SHED BY CATTLE DURING FEEDING.

By GEO. A. GILL, Botanist, Grootfontein School of Agriculture.

When veld has deteriorated in grazing quality the practice of deferred grazing may often be used with good results in order to improve it. The grazing-land of the farm may be dealt with piecemeal in convenient-sized portions until the whole has been treated. Once the whole farm has been raised to the requisite grazing level the treatment may then be applied in sequence to the various camps in order to maintain the standard which has been attained.

In this system of veld management the veld is rested from all grazing during the whole of the growing season, that is, from spring until autumn. After the seed crop has ripened in autumn, stock are allowed to graze during the winter and until growth starts again in the spring. The mechanical action of the animals in walking over the veld helps the seeds to be shed and afterwards to be trampled to some extent into the soil.

Seed Crop.—The seed crop itself should be a good one as there has been no check to the veld plants during its production. Under the circumstances a good seedling growth may be expected on bare places with the advent of the next spring rains.

The next season the same resting process is repeated. The seedlings which have come up thus grow undisturbed and are able to establish themselves firmly. Again a good seed crop will be matured. In the winter stock are put in as before, but care must be taken not to graze so heavily that the regeneration growth of the previous season is damaged. The following and subsequent seasons the procedure of resting during the

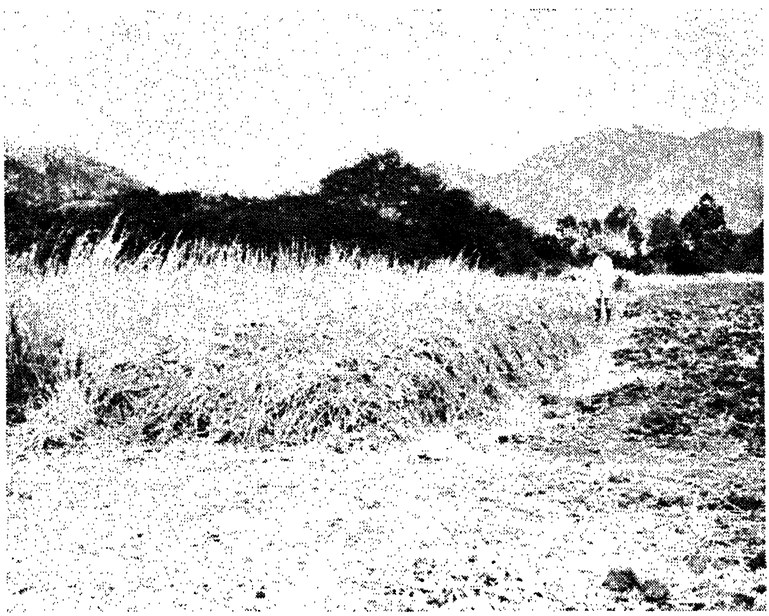
summer and grazing only during the winter can be continued until the farmer is satisfied that he has obtained the desired improvement. This piece of veld is then taken into the summer grazing system, and another portion set aside for renovation.

Better Results.—Deferred grazing often appears to give much better results than where very long resting periods are allowed without any stocking whatsoever. It also has the recommendation, on economic grounds, that an appreciable grazing return can be obtained from the treated land even though the grazing may not be utilised at its most nutritious period.

This system of grazing is most successful on types of sweetveld where the veld retains a fair proportion of its palatability during winter. In sourveld, where the grazing becomes poor and unpalatable in winter, it is less effective and may need to be supplemented by spring burning in order to clear away the surplus dead grass remaining after the winter grazing.

A 16 ft. wide kraal filled with trampled sunnhemp in it to a depth of 18 inches.

Side view of a kraal just as it was being moved.



The heap of sunnhemp after moving the kraal and rebuilding into a heap 9 feet wide by 3 feet high.

Composting the Sunnhemp Crop

By P. Gordon Deedes.

The following notes on the composting of the sunnhemp crop are given, after practical experience in composting about 35 acres, with the hope that they may be of use to others who contemplate following this method of dealing with the green manure crop, in the place of the present practice of ploughing it under.

Careful costs, which are given below, were kept, and the opinion was formed that by composting the crop a far more regular and dependable method of manuring would be obtained, which would amply repay the small outlay involved, and which would of course materially reduce the acreage normally lying idle under green manure.

Furthermore, the crop was dealt with after the rains were over, and the unsatisfactory business of trying to get the ploughs into the lands in the middle of the rainy season, often with disastrous results to the tilth, was eliminated. Incidentally, during the composting, we had on one occasion (on April 3rd) a precipitation of 1.50 inches of rain, but this did not in any way affect the hemp, as it was simply raked up and forked over into the kraal the following morning.

As the crop was dense and therefore free from weeds, mowing presented no difficulties, apart from the fact that a "piccanin" was told off to follow the mower and clear the sunnhemp, which had a tendency to fall back on to the uncut hemp. If weeds (due to a poor stand of sunnhemp), which at that time of the year might tend to be matted, are experienced,

the possibility of the knives clogging can be overcome by inspanning two more oxen to the mower, and detailing a "boy" to drive them and keep them well on the move.

Raking was done after the sunnhemp had been allowed to wilt for one day, and thereafter cocking was carried out by hand, in this case for want of a hay sweep, which, if it had been available would have naturally helped to reduce the costs of labour.

For sweeping the hemp up to the temporary kraals, a drag of home-made construction was used, and with two intelligent drivers, sufficient sunnhemp was dumped alongside, in a matter of half a day, to keep the kraal supplied with bedding for three or four days.

The kraals were constructed of gum poles and odd pieces of barbed wire, the dimensions being 16 feet wide, and as long as was deemed to be necessary for the acreage of sunnhemp to be composted. In my case I found, with a lucky guess (for want of previous experience) that in order to compost 5 acres of Somerset sunnhemp, broadcasted 40 lbs. to the acre, and standing seven to eight feet high, a kraal of 70 yards in length was necessary to give a final depth of 18 inches of trampled sunnhemp. In this particular kraal 32 head of oxen were accommodated nightly for twenty-four nights, though next year I shall make my kraals to the desired length but with a division every 30 yards, which spacing I find comfortably accommodates a span, enabling them on entry to have their evening feed of sunnhemp and then distribute themselves along the full length of the kraal without being overcrowded. Separating the spans, of course, helps to reduce "horning" to a minimum.

Turning the sunnhemp into the kraals was carried out daily by three boys; two forking it over and one bedding it down. As the sweep tended to compress the heaps, and consequently make the work of forking it over more difficult, piece

work was found to be the best way to get through this operation.

As soon as the sunnhemp had been trampled to a depth of 18 inches, and well impregnated with urine and dung, the kraal was removed and half the dressing of woodash and top soil applied. Thereafter the whole heap was reduced in width to 9 feet, which finally gave it a height of about 4 feet, and when this had been completed the other half dressing of woodash and soil was applied to the top of the heap, which was then left to await next season's rain to complete the process of rotting.

A little difficulty was experienced in reducing the size of the heaps owing to the amount of "give" in the compost, and cutting with badzas simply curled them like paper. Finally small native axes were used, but probably the solution would be to cut out badzas from discarded plough discs, as the steel would keep an edge better than either the axe or the mattock. Alternatively, perhaps, heavy hay cutting knives would cut the compost, after the few loose inches at the top had been dealt with.

In conclusion, I would add that I think the economy of the method would depend to a large extent on a good growth of sunnhemp, and if therefore composting was to be used to reduce the area of land idle under green manure, it would pay, where necessary, to fertilise with phosphates in order to ensure a good heavy growth.

COSTS OF COMPOSTING THE SUNNHEMP CROP.

Items.	Cost in pence per ton based on estimated yields of finished compost per acre of**		
	10 tons.	12 tons.	14 tons.
1. Mowing	1.15	0.95	0.81
2. Raking into windrows... ...	0.49	0.41	0.35
3. Cocking and refilling kraal	1.31	1.09	0.94
4. Sweeping up to kraal side	0.98	0.82	0.70
5. Refilling kraal with sunnhemp	1.31	1.09	0.94
6. Digging soil and dumping soil and ash alongside of compost heap in measured quantities	0.65	0.54	0.46
7. Spreading soil and ash over compost, and rebuilding 16 feet heap into 9 feet wide heap...	1.96	1.64	1.40
8. Turning compost 4 times next summer at 3.0d. per ton*	3.00	3.00	3.00
Total cost of labour	10.58d.	9.54d.	8.61d.
9. Depreciation on kraal†...	0.32	0.27	0.24
10. Depreciation on mower and rake‡	0.51	0.42	0.36
Depreciation on haysweep and drag‡	0.11	0.09	0.07
Total cost of labour and depreciation and upkeep on implements and kraal ...	11.79d.	10.32d.	9.28d.

N.B.—Items 1 to 7 are the actual costs. Items 8 to 10 are estimates made by officers of the Department of Agriculture.

**The cost of labour per ton of compost naturally depends on the yield of finished compost per acre of sunnhemp. In this case it is estimated to be between 10 tons and 14 tons. The crop was well grown, being 7 to 8 feet high, and a good stand. The soil was a chocolate loam in good heart, capable

of yielding upwards of 15 bags of maize per acre after green-manure, and it is probable that the yield of compost will be at least 12 tons per acre.

*This is an estimate of the cost of turning three times during the next summer and is based on considerable experience in this Colony.

†The original cost of the kraal is taken as £3 0s. 0d., and its "life" as 8 years if the posts are treated by soaking in the dip-tank, or as advised in Departmental Bulletins Nos. 769 and 791, and stored when not in use.

‡The "life" of the mower and hay-rake is taken as 15 years if 300 acres of sunnhemp are mown each year. The cost of the mower (£32 10s.) and upkeep for the 15 years is estimated at £70, and the cost of the rake (£20) and upkeep for 15 years at £35—a total of £105 for both the original cost and upkeep for the 15 years of the two implements.

The original cost of the haysweep and hay drag (made on the farm) is taken at £5 for the two; their "life" as 5 years; and upkeep at 10s. per year. Actually a haysweep was not used for the cocking, which was done by hand, but the depreciation and upkeep on this implement is included, since it will normally be employed for this work. The type of haysweep is that described and illustrated in Bulletin No. 1048. It is home-made and ox-drawn.

Cost of Labour.—The rates of pay of the labour employed have been taken, including food, at 30s. per month for a driver; 15s. per month for the ordinary farm hand; and 15s. per month for a "leader."

The cocking was done by hand labour as a sweep was not available, and the cost of this item is therefore high. The use of a sweep would have reduced the cost of this operation materially.

With the mower, one driver, one leader and one "boy" following it to clear the cut sunnhemp away from the standing crop were employed. For sweeping the cocks up to the side of the kraal a hay "drag" as illustrated and described in Bulletin No. 1048 was used. Two drivers and two leaders were needed for this work.

No cost of ox-labour is taken into account nor of upkeep of trek-gear. The cost of labour for sweeping the sunnhemp up to the kraal side is on the low side, since the "haul" to the kraal was short, being only about 100 yards on the average. If the average "haul" is taken as half the maximum "haul" and if kraals are placed on both sides of a field, it is considered that the average "haul" on a farm would not exceed 200 yards.

Editorial Note.—Further experience of this system of utilising the sunnhemp crop at the Salisbury Experiment Station indicates that full rates of soil should be added in composting this rather tough material in order to get good breakdown. The following rates of soil and wood ash or lime are advised:—

For every 9 yards length of the heap, after moving the kraal, the following should be applied (in two portions as described by Mr. Deedes).

Top soil	12 grain bags full.
Wood ash	1 to 2 bags full.
or Agricultural Lime	$\frac{1}{3}$ to $\frac{2}{3}$ of a bag full.

In addition farmers are advised to sow velvet beans and sunnhemp very thickly on the surface of the heap just before or after the seasonal rains commence. The seed can be covered with the soil applied to the top of the heap. This will help to ensure an ample nitrogen supply for the process. These legumes should be allowed to grow for about one month before the next "turn." A dressing of any phosphatic fertiliser will help their growth and cost little.

Report on Soya Beans from Southern Rhodesia.

[*We wish to express our sincere thanks to the Director of the Imperial Institute for the following valuable report on the samples of soya beans sent from the Salisbury Experiment Station.*—Ed.]

The seven samples of soya beans which are the subject of this report were forwarded to the Imperial Institute by the Agriculturist at Salisbury, and are referred to in his letter No. 1220/2/16 of the 17th June, 1938.

The beans had been grown on the Salisbury Experiment Station, and it was desired to ascertain their quality and commercial value. Information was also requested as to the types of soya beans required in the United Kingdom, and whether the colour of the beans has an influence on their market value.

It was stated that the varieties Biltan and Otoxi gave the best yield of beans, while the yields from the other varieties at present preclude the possibility of their being grown on a commercial scale.

Description.—The samples weighed about 1 lb. each, and were as follows:—

67/37—Yellow beans of normal appearance, many with a slight greenish tint. The sample was in clean, good condition.

Rokuson 86/35.—Flattish, golden-brown beans; mostly lacking in plumpness, and some rather shrivelled. The sample was in clean condition.

Seb 66/37.—Yellow beans of normal appearance, in clean, good condition.

Otoxi.—Olive-green beans in clean, good condition.

Herman.—Yellow beans of normal appearance, some having a greenish tint. The sample was in clean, good condition.

White Non Shatter.—Yellow beans of normal appearance, some with a greenish tint and many lacking in plumpness. The sample was in clean condition.

Biltan.—Black beans ,in clean, good condition.

Results of Examination.—The samples were examined with the following results. The figures for the oil content and percentage of proteins are also shown calculated on a 12 per cent. moisture basis, this being the normal moisture content of commercial Manchurian soya beans.

Sample.	Weight of 100 beans.	Expressed on beans as received.			Expressed on beans containing 12% of moisture.	
		Moisture.	Oil.	Protein.	Oil.	Protein.
	grs.	%	%	%	%	%
67/37	23.1	8.9	17.2	41.9	16.6	40.5
Rokuson 86/35	21.5	8.9	18.5	35.1	17.9	33.9
Seb 66/37... ...	18.2	9.4	17.2	38.1	16.7	37.0
Otoxi	16.5	9.1	16.6	43.3	16.1	41.9
Herman	15.9	8.8	18.1	36.8	17.5	35.5
White Non Shatter	17.7	9.3	18.4	36.4	17.9	35.3
Biltan	13.2	9.7	17.7	39.2	17.3	38.2

The results of the examination expressed on a 12 per cent. moisture basis show that the varieties "Rokuson 86/35" and "White Non Shatter" contained most oil, and "Otoxi" the least. As regards protein content, "Otoxi" and "67/37" were richest, and "Rokuson 86/35" poorest. There is a tendency for the higher oil content to be associated with the lower percentage of protein.

Manchurian soya beans contain on the average 12 per cent. of moisture, 18 per cent. of oil and 38 per cent. of proteins. Of the samples in the present series, "Biltan" is the one which approximates most closely to Manchurian beans as regards oil content and percentage of protein, but the "Biltan" beans are black whereas the Manchurian are yellow.

Commercial Value.—The samples were submitted for a trade opinion to one of the largest firms of oilseed crushers in the United Kingdom, who reported as follows:—

"Manchurian soya beans have had a value during the last year or so of about £7 to £8. Similar quality Rhodesian beans would be worth this plus 10 per cent., which is the import duty payable on Manchurians into this country. For exports to other countries of Europe they would, of course, not get the benefit of the 10 per cent.

Manchurian soya beans have an analysis of 12 per cent. moisture, 18 per cent. oil and 38 per cent. albuminoids. Actually we think the Rhodesian soya bean would, in practice, have 12 per cent. moisture, as no doubt the samples have dried out considerably. If they contain 12 per cent. moisture you would have to deduct about 1 per cent. from the oil, and about 2 per cent. from the protein, shown on your analysis. The value of 1 per cent. of oil at the moment is about 2s. 6d. per ton, and for rough calculation you could take 1 per cent. of protein as worth 2s. 6d.

We do not advise planting black soya beans, as though intrinsically they are the same value they would be very difficult to market owing to their colour; in fact, we very much doubt if large quantities of them could be sold within 10s. per ton of yellow. It would be impossible to use the meal of black beans in pig foods, as it would spoil the colour of the meal. In cattle cakes it would not matter so much, but at the same time we do not think it would be advisable.

We hardly imagine that with the freights that have to be paid from Rhodesia this would be a paying crop for export to this country, though, of course, they may be able to find a market locally for a small quantity."

The current price of Manchurian soya beans in London is £7 17s. 6d. per ton, excluding duty. Southern Rhodesian soya beans containing 12 per cent. moisture, 18 per cent. oil and 38 per cent. protein would therefore be worth £8 13s. 0d. per ton. On the basis of calculation given above in the crushers' report, soya beans with the composition of the

samples in the present series would be valued at the following prices per ton (in assessing which the colour of the beans is not taken into account):—

67/37	£8	15	9
Rokuson 86/35	£8	2	6
Seb 66/37	£8	7	3
Otoxi	£8	18	0
Herman	£8	5	6
White Non Shatter	£8	6	0
Biltan	£8	11	9

In the case of the varieties which are not yellow the above prices would not be realised in practice for the reason given by the crushers.

Remarks.— Oilseed crushers prefer yellow soya beans and other colours are difficult to sell. It is therefore unfortunate that of the present varieties the only two which gave yields of commercial interest, *i.e.*, Otoxi and Biltan, are both of dark colour. Such varieties would not find a ready market in western countries, though they might be found useful in Southern Rhodesia.

If it is decided to continue experiments in growing soya beans in Southern Rhodesia with a view to export to the United Kingdom, it would be advisable to carry out further tests using other yellow varieties.

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VITAMINS.

THEIR IMPORTANCE IN MAINTAINING HEALTH, GROWTH AND PHYSIOLOGICAL FUNCTIONS IN STOCK.

By J. S. ADAMSON, M.R.C.V.S., B.Sc., D.T.V.M.

In the nutrition of animals, in addition to the better known food constituents such as carbohydrates, proteins, salts and minerals, vitamins, or accessory food factors, play an important role.

These vitamins are substances contained in certain foods which, if given even in minute amounts, have a profound effect on the metabolism of animals out of all proportion to the quantities consumed.

The lack of these vitamins even in rations which are adequate in all other respects leads to unhealthy conditions, which have come to be known as Deficiency Diseases.

It is only during the past half-century that any great knowledge of the existence and functions of vitamins has been accumulated, and most of the work has been done by experimentally producing the Deficiency Disease in laboratory animals by withholding the various vitamins in their food and noting the effects, and also again by noting the resultant changes when the missing element is supplied.

From these deductive experiments a considerable number of vitamins have been discovered and isolated from the foods, and in certain cases their chemical formulae has been worked out, making it possible to manufacture them commercially.

The most important of the vitamins have been classified as under:—

(1) Vitamin A	(4) Vitamin D
(2) Vitamin B	(5) Vitamin E
(3) Vitamin C	(6) Vitamin K

As already mentioned, most of the experimental work elucidating the vitamin problems has been done on laboratory animals, such as rats, mice, guinea pigs and pigeons, but sufficient general principles have been arrived at as a guide for domestic stock requirements.

At the outset it is important to point out that under normal natural conditions of good grazing and the feeding of natural foods which have not undergone any commercial preparation which is likely to destroy the essential vitamin element, there is little likelihood that stock suffer from a vitamin deficiency.

Green growing grass contains all the necessary vitamins for stock, probably in adequate amounts. During the long dry season, however, veld grazing animals, young growing stock, pregnant and milk producing stock are likely to be existing on a subnormal vitamin intake, and thus suffering from Deficiency Disease to a more or less degree.

With a view to aiding the stockowner to recognise these deficiency conditions and to combat them, it is intended to give a description of the functions of the various vitamins, their source of supply, their biological functions, and the conditions that result from a lack of vitamin in the ration.

VITAMIN A.

Vitamin A is a fat soluble vitamin and is stored in the liver fat of animals.

In nature it is found in green grass, green vegetables, fresh fruit, good hay, eggs, liver, fish roe, cod liver oil, and in the germ of some grain, notably yellow maize.

In the plant world it does not occur as the actual vitamin, but as a pigment substance called carotene—a precursor of Vitamin A.

The animal body is able to transform carotene into Vitamin A and store it as such, the most important storage site being the liver.

Carotene is a pigment and is found in abundance in young actively growing grass and is responsible for the natural rich yellow colour in milk and butter.

It is found in yellow maize, but not in white maize. Grazing animals and poultry obtain an abundant supply from actively growing green grass and forage plants.

When an abundant supply is available in addition to supplying their bodily requirements animals store up a reserve supply in the liver, and an excess is excreted in milk and butter, which under these conditions is a source of Vitamin A.

The vitamin content of milk varies greatly during the wet and dry season, according to the activity of growth in the grazing.

Hay is a good source of Vitamin A, provided it has been cut when growth was active. A good guide to the vitamin content of hay is the amount of chlorophyl or greenness that it retains after curing.

In making hay, however, a good amount of the carotene is lost even under the best conditions, as both carotene and Vitamin A are gradually destroyed by oxidation which takes place in bright sunlight, and the Vitamin A content of hay unduly exposed to sunlight or to long exposure to wet weather, may practically be nil.

Hay more than a year old will contain practically no Vitamin A.

Fermentation in badly stacked hay will also ruin the vitamin content.

Of the cereal grains yellow maize is practically the only one to contain Vitamin A.

Colostrum, or beasty milk, contains ten times more Vitamin A than milk.

Carrots and the outer green leaves of vegetables are a good source of supply, but the most concentrated source of all is cod liver oil.

Functions of Vitamin A.—The function of Vitamin A was first deduced from the effects produced by feeding a ration totally lacking in Vitamin A to young growing rats. The ration in all other respects was adequate.

After a period during which the Vitamin A reserves in the bodies of the rats were exhausted, these animals ceased to grow.

When Vitamin A was again supplied, growth was renewed.

Attendant on the cessation of growth when the vitamin was withheld, several characteristic symptoms occurred, notably opthalmia, conjunctivitis, corneal ulcers.

The epithelial lining of the alimentary, respiratory, urinary and reproductive system showed changes, resulting in gastric enteritis, bronchial troubles, urinary calculi and abortion.

The result of these epithelial changes is that the resistance to invasion of the body by microbes is reduced, thus the resistance to disease is reduced.

In addition the nerves of the body degenerate and different forms of paralysis occur.

In countries where prolonged droughts occur and the grazing is sun bleached, and growth is inactive, the following conditions have been noted amongst stock:—

(1) Premature births or calves born dead at full term.
(2) Severe diarrhoea in weak and new-born calves.
(3) Opthalmia in young growing animals.
(4) Fertility of the herds reduced (reduced birth-rate).

These conditions are produced by lack of Vitamin A.

The above picture agrees with histories very often met with in this territory in drought seasons, and there can be no doubt that on sun-bleached veld grazing must be very poor in Vitamin A. If the drought period is long enough to exhaust the Vitamin A reserves in the stock, the unhealthy symptoms of the deficiency assert themselves.

There is also evidence being built up that certain rheumatic conditions are due to a lack of Vitamin A, espesially in cattle and horses. In Britain, at the end of the winter season, cattle in byres often show lameness and stiffness, which soon passes off when the animals have access to green grass in spring or are fed a concentrate of Vitamin A.

It is a general observation that unthrifty animals are prone to parasitic diseases, and it has been proved that lack of Vitamin A in the diet predisposes to parasitism (worms, lice and scab).

The general observation is also that worms, lice and scab are usually winter diseases, or worse in winter, and disappear with the coming of spring and green grass.

Vitamin A in Relation to Cattle.—This vitamin is necessary for vigorous growth of stock and progeny. It is required for healthy reproduction, both in the male and the female, and for the normal lactation in the female. It is also necessary, especially in young animals, to build up a body resistance to the invasion of harmful bacteria.

Vitamin A in Relation to Pigs.—A deficiency in Vitamin A leads to a state of paralysis, poor reproduction, eye troubles, nerve degeneration, and a susceptibility to disease.

Vitamin A in Relation to Poultry.—Deficiency in Vitamin A leads to disease of the mucous membranes of the mouth, pharynx and nasal passages, and the eyes may also be affected. Kidney troubles also are present.

Epidemics among chickens showing diarrhoea and sore eyes should lead to suspicion of Vitamin A deficiency, and the feeding of yellow maize, even when no green food is available, has cleared up this condition.

Vitamin A plays some part in egg production of poultry.

Remedy for Vitamin A Deficiency.—Cattle.—The growing of green winter crops to supply Vitamin A during the period when the veld grazing is deficient is indicated.

Preserving good quality hay for winter feed.

Feeding silage made from green grass and green forage plants, and yellow maize, and where possible adding at intervals cod liver oil, will supply Vitamin A.

A word of caution is necessary in regard to the storage and supply of cod liver oil.

Vitamin A readily oxidises in the presence of air and sunshine. The cod liver oil should be stored in containers

and in places which will prevent sunlight reaching it. It should be added to the ration immediately prior to consumption.

Proprietary foods and cakes which combine cod liver oil as a supply of Vitamin A are often disappointing, as the vitamin has been oxidised and lost in storage.

The necessity of new-born calves obtaining plenty of colostrol or beasty milk which nature specifically makes rich in Vitamin A is indicated.

Pigs and Poultry.—The most suitable sources of supply are yellow maize, lucerne, outer leaves of vegetables, and cod liver oil.

VITAMIN B.

This is an anti-neuritic vitamin concerned with beri-beri and pellagra disease in human beings.

It occurs in the bran coat and the germ of grain, and if these are removed in milling processes lack of the vitamin results in pathological conditions of the nerves.

As far as ruminants are concerned it has been found that these animals can synthetize and produce the vitamin by the action of bacteria on the food in the rumen, and no deficiency diseases result among such stock due to lack of Vitamin B. Similarly horses can synthethize it in the colon.

In poultry, however, similar conditions to beri-beri can be set up, manifested by a rapidly fatal paralysis. Vitamin B is concerned with the growth and maintenance of weight in birds.

Under natural out-door conditions poultry do not suffer from Vitamin B deficiency, but if housed and fed on unsuitable mashes in which the bran coat of the grain has been removed, the condition is possible.

Access to whole grain will remedy the condition and young growing chickens will benefit from the addition of a little yeast to the feed.

Dogs, however, may be affected by lack of Vitamin B, resulting in digestive troubles and paralysis owing to being

fed on a badly balanced ration. It has also some action on the skin, and lack of Vitamin B may result in some form of dermatitis.

The most abundant source of Vitamin B is yeast or marmite, which is made from yeast.

VITAMIN C.

This is an anti-seorbutic vitamin, of more medical than veterinary interest.

Lack of it causes scurvy in humans. Little is known regarding the requirement of Vitamin C for stock, but it appears that they can manufacture it in their own bodies.

Animal products, such as milk fat and raw meat contain only small amounts of Vitamin C.

Fresh fruit, vegetables, roots such as Swedes and potatoes, are the most abundant source of Vitamin C.

VITAMIN D.

This is an anti-rachitic vitamin, of great interest both to medical and veterinary science.

It is essential to all types and species of domestic animals.

The sources of this vitamin are very restricted in natural foods, but to compensate this it can be prepared commercially in concentrated form from the action of ultra violet rays on ergosterol.

In nature it is found in good sundried hay, but vegetable foods do not contain any appreciable amounts. Halibut and cod liver oil are the most abundant sources.

The substance ergosterol is present in the skin of all animals and the action of the ultra violet rays of the sun on it can produce Vitamin D. In this country of bright sunshine, therefore, it would appear that Vitamin D need not worry stockowners. There is, however, an associated mineral problem, which is of vast interest to the stockowners in the African Continent, and which will be obvious on studying the function of Vitamin D.

Functions of Vitamin D.—The function of Vitamin D is bound up in some complex manner with the calcium-phosphorus metabolism of the body which results in the formation of bone.

Rickets is really a disease resulting from a disturbance of the metabolism of these minerals, and an upset of the balance of the minerals as well as lack of Vitamin D can result in rickets.

It is considered that Vitamin D is required for the fixation of the calcium and phosphorus in bone.

In the presence of sunlight the body can produce Vitamin D. In the absence of sunlight Vitamin D will not be produced, and it is necessary therefore to supply it in the ration.

The amount of Vitamin D required, however, varies with the level of the minerals in the diet, and when the supply of minerals is low the amount of vitamin required for fixation is high.

Again, the amount of minerals required varies according to the state of growth and according to the sex of the animal.

Bone formation in young growing stock makes a heavy demand on the system, both of minerals and Vitamin D. The pregnant female makes heavy calls for the formation of the foetus. Lactating cows pass large quantities of calcium and phosphorus daily in the milk, which has to be assimilated in the system through the agency of Vitamin D.

In any of the above conditions if adequate supply is not available in the ration of either minerals or Vitamin D, the animal falls back on its bone structures and depletes the bone, to provide for a supply of minerals in the blood stream for the more fundamental requirements of foetus and milk. The result is a condition of spongy bone which is unable to support the weight of the body, which results in a deformation of the bone or rickets.

An inadequate supply of any one of the minerals will cause the same condition, and in the feeding of calcium and phosphorus the ratio of the one to the other is important. The best calcium-phosphorus ratio appears to be in the vicinity of 1:1.

In the presence of an abundant supply of Vitamin D and calcium and a low intake of phosphorus, varied degrees of rickets can still be produced, which are so well known in South Africa, associated with bone pica and lamsiekte disease.

Lameness, stiffness and enlarged joints are also a train of symptoms in the deficiency of minerals and Vitamin D. These are indications that these deficiencies are also involved in South African stiff-sickness.

Between the animal in good health receiving adequate minerals and Vitamin D and the extreme case of "acute" ricketty mineral and Vitamin D deficiency, there are graded cases. Such cases foreshadows stunted growth in stock, reduced milk yield, weakly calves, infertility of cows, longer maturing periods, sexual functions retarded, increased mortality, all of which are a serious commercial loss to the stockowner.

In one South African experiment on a mineral deficient pasture the addition of minerals to the feed increased fertility from 51% to 80%. Calves were born in a healthy condition and in fifteen months were double the weight of calves of the same age not receiving the minerals.

Mortality in the mineral fed herd was 9% as compared with 66% in the mineral deficient herd.

From the foregoing it will be seen that the problem of Vitamin D deficiency cannot be separated from that of the supply of bone forming minerals.

In this territory the problem is more of a mineral deficiency problem, since we have plenty of sunshine at any period of the year. It has been shown, however, how this mineral problem may result in a demand for a higher supply of Vitamin D, and in actual proof cattle have been shown to improve in condition when Vitamin D in the form of cod liver oil has been supplied, indicating that the natural supply can be improved.

In the dry seasons in this territory all stock show loss of condition out of all proportion to the quantity of grazing available. Weaners go back in growth; calving troubles appear; cows in poor condition have difficulty in taking

services, and there is reduced calf-crop subsequently; milking cows rapidly lose condition and become dry.

Vitamin D in Relation to Cattle.—The foregoing remarks apply for cattle. Vitamin D is required for the assimilation of bone-forming minerals in the food, for the requirements of the bone skeleton, the foetus, and the milk supply.

The main conditions that result from a deficiency have been indicated and the importance of the mineral requirements of animals as an associated problem, especially for young growing stock and breeding cows.

The health of the calf and its promise of development into a good specimen of its species is largely influenced by the pre-and post-natal feeding of the mother. If the dam received a satisfactory ration including minerals and vitamins the offspring are definitely less susceptible to disease and make better growth.

In this respect the commonly but aptly named "Separator Disease" of calves is an indication of vitamin deficiency. Fresh cow's milk contains at least some of all the vitamins, but separated milk is practically deficient in Vitamins A, D and E.

Vitamin D in Relation to Pigs.—The functions of Vitamin D in pigs is as in cattle, but housed pigs do not receive the same benefits from sunlight and are more liable to Vitamin D deficiency.

Rheumatism, stiffness, enlarged joints and ricketty conditions result if a deficiency of minerals or Vitamin D occurs.

Vitamin D in Relation to Poultry.—Vitamin D is of vast importance to the poultry industry. The knowledge of the functions of Vitamin D and the means of supplying a source either in the food or by artificial sunlight has enabled intensive production under artificial conditions.

Leg weaknesses were previously a cause of high mortality. This has been found to be due to Vitamin D deficiency in the case of confined birds. Addition of cod liver oil or lucerne meal to the feed, or adequate exposure to sunlight or artificial sunlight in the form of the various types of ultra-violet lamps effects a cure by supplying the missing vitamin.

The hatchability of eggs is influenced by the lack of Vitamin D.

British workers have found that in eggs laid in the poor sunlight conditions of late autumn and winter in many cases the chicks died in the shells. Such eggs also were of poor shell quality. The exposure of the birds to ultra-violet radiation markedly improved the hatchability of the eggs, reduced the number of deaths in the shell, and resulted in stronger and better formed shells containing more calcium than those formerly produced. The assimiliation of calcium and phosphorus by the hen was also increased.

It is necessary to repeat, however, that poultry in this country having access to sunlight daily are in no danger of Vitamin D deficiency, but if leg-weakness in chickens should occur, the addition of good quality cod liver oil or lucerne meal may be of benefit.

Remedy for Vitamin D Deficiency.—The remedy for Vitamin D deficiency consists of:—

(*a*) Adequate supply of sunlight and addition of cod liver oil or lucerne meal as a source of Vitamin D.

(*b*) Attention to the mineral requirements of the food of the animal.

VITAMIN E.

Vitamin E is the reproduction vitamin.

This vitamin has a wide distribution in cereal grains and hay, but only in very small quantities. The richest source is the germ of wheat, and concentrated supplies are manufactured by extracting the oil from wheat germs. The germ of maize is also another good source of supply. Fresh green vegetables usually contain a small amount, but it disappears on wilting.

Function of Vitamin E.—This vitamin is directly concerned with the physiology of reproduction in both the male and female.

In the absence of Vitamin E males become sterile. Females continue to come into season, but service does not result in pregnancy.

The deficiency does not act the same in both sexes. In the male the deterioration is slow and results in changes in the testes and the spermatazoa, the final result being that abnormal spermatazoa are produced, incapable of producing pregnancy.

In the early stages before any distinct anatomical changes have occurred, the supply of Vitamin E may rectify matters and regenerate the parts. If the changes have gone too far, sterility is the result.

In the female deficiency does not affect the ova, but results in changes in the placenta, giving rise to inadequate nourishment of the foetus. When the changes in the placenta become extensive the foetus ceases to develop and dies.

Both the foetus and the membranes may be aborted, or the foetus may be reabsorbed in the uterus.

If the deficiency of Vitamin E is only partial the foetus may be born, but be abnormal.

Intermediate results between reabsorption and birth of a sickly calf may occur, and Vitamin E has been incriminated for non-specific abortions apart from contagious abortion.

In the past it was considered that no permanent damage was done to the reproductory system of the cow by reabsorption from such abortions, but it is now believed that if reabsorption of the foetus occurs fertilised ova are not capable of being fixed or implanted upon the uterine wall.

There is evidence that Vitamin E is required before sexual maturity can be arrived at, and also that it is essential for proper lactation.

Vitamin E has some effect on growth, but it appears to act more in this direction after sexual maturity has been reached.

The muscles in Vitamin E deficiency suffer changes, and appear to lose their response to nerve impulses. This condition may be the cause of the paralysis noted in new-born calves from dams existing on a Vitamin E deficiency ration.

A deficiency of Vitamin E may cause poultry losses. Vitamin E is a necessary constituent of eggs and is essential

for the development of the chick in the egg. A deficient supply in the egg results in varying degrees of non-development from complete infertility to the hatching out of weakly chicks. Between these extremes the chicks may die in the egg at any stage of development.

To the laying hen, therefore, an adequate supply of Vitamen E is a necessity for the fertility and hatchability of her eggs.

The absence of Vitamin E has an adverse effect on the hen herself, resulting in a lack of vigour and a susceptibility to disease. Fowl paralysis, a disease which has only been noted within recent years, has been experimentally produced by feeding chickens on Vitamin E free diet.

Also the disease has been successfully treated by the injection of wheat germ oil which contains a concentrated supply of Vitamin E.

Vitamin E in Relation to Cattle.—Vitamin E is a very essential vitamin to the reproductory system of all animals, and as the breeding or increase of stock is the keystone of animal economics, it is of vast importance that anything which will assist to develop and strengthen this reproductory system should be taken advantage of. The present day farm stock are highly developed and domesticated, and normal natural supplies adequate for more natural types must fall short of sustaining these highly efficient milk and egg factories. The lactating female is not allowed her natural non-milking period for recuperation, but machine-like must produce milk almost to calving date, and the domestic fowl is encouraged to produce more than one egg in every 24 hours.

This un-natural efficiency means that more than natural supplies of raw material must be supplied to these animal product manufacturers.

This high order of production has resulted in disorders of the reproductory system amongst stock, increasing as the animal gets further away from natural levels.

It is clear, therefore, that for reproducing animals an adequate supply of the factors required for the control of the reproductory phenomenon is necessary, or else the mechanism fails.

It has been found practical therefore to ensure and safeguard healthy reproduction and prevent the frequent overstrain of reproduction by supplying either small and frequent doses of Vitamin E, either in the food or by injection, or by giving larger doses at longer intervals.

Vitamin E can be given daily in small doses or in one large dose.

In cattle especially wheat germ oil may be injected subcutaneously or intra-muscularly, and it is claimed that females which have previously consistently aborted can be made to carry a healthy calf to full term by this method.

The injections have been made just before or just after coming to season.

In France it has been claimed that cows suffering from contagious abortion have been made to calve normally by injecting wheat germ oil at about the time of service, and again at the third and sixth months of pregnancy.

It is stated that in this way losses due to abortion and subsequent decreased milk yields have been avoided.

Many previously sterile cows have produced calves under this procedure.

There appears to be some evidence that Vitamin E stimulates the flow and increases the yield of milk.

The problem of sterility in the male can be treated in the same way, provided it is tackled early enough. Injections of wheat germ oil just prior to and during his service season are indicated so that the vigour of the spermatazoa may be maintained.

Vitamin E in Relation to Pigs and Sheep.—The remarks in relation to reproduction in cattle apply equally to pigs and sheep.

The germ of maize contains Vitamin E, and addition of this grain will supply a certain amount to these animals. Yellow maize should be given in order to supply Vitamin A at the same time.

Vitamin E in Relation to Poultry.—The importance of Vitamin E in poultry has already been dealt with under the functions of Vitamin E. Supplies are required by the laying hen to pass on in the making of eggs so that fertility and hatchability result.

Remedy for Vitamin E Deficiency.—The remedy for Vitamin E deficiency consists of:—

(*a*) Supply of whole grain in the ration to include the grain germ, especially wheat and maize.

(*b*) Feeding in the ration, or the intra-muscular or subcutaneous injection of wheat or maize germ oil.

VITAMIN K (Anti-Haemorrhagic Vitamin).

Absence of this vitamin in the diet of experimental chickens results in haemorrhage.

Vitamin K has been found in hog liver fat, hemp seed, lucerne, cabbage, spinach and tomatoes.

It would appear that this vitamin is absorbed into the system through the action of bile acids, and that when absorbed it controls in some manner the prothrombin, *i.e.*, the clotting element in blood.

Lack of Vitamin K results in a low prothrombin content of blood and a consequent lack of clotting power.

Absence of Vitamin K in the diet of experimental chickens gives rise to haemorrhages and anaemia with a pathological condition of the gizzard. The haemorrhage may be internal, intra-muscular or subcutaneous.

This bleeding is associated with a fall in the amount of prothrombin in the blood, and the administration of hog liver fat or lucerne cures the condition.

The work on this vitamin is very recent, and no great knowledge of its practical application to stock is yet available.

From the foregoing it is evident that the vitamins of interest to the stockowners are mainly A, D and E.

In this territory, after prolonged spells of dry weather, it would appear that considerable benefit could be derived by the stockowner by arranging for his stock to receive silage, green winter crops or cod liver oil as a source of Vitamin A.

Vitamin D might profitably be supplied to young growing stock and breeding females and fattening stock, but the main problem is the supply of bone-forming minerals, and it is hoped that the explanation of the inter-related functions will encourage stockowners to supply calcium and phosphorus in the form of bone meal and so to young growing and breeding stock ensure a supply of Vitamin D.

Vitamin E may or may not present a problem in this territory, but where breeding troubles exist its possibility should be kept in mind. Feeding a ration containing maize for the sake of its germ would probably solve the trouble, and in cases of sterility in better bred stock the suggested feeding or injection of wheat or maize germ oil might repay the trouble taken.

Cleanliness Aids Insect Control

in Lands and Sheds, Stores and Farmsteads.

Immunisation against Horse-sickness.

By H. THEILER, Division of Veterinary Services, Onderstepoort.

In 1932 it was found possible to pass the virus of horse-sickness from mouse to mouse by injecting the material into the brain. While becoming more virulent for mice—regularly killing 100 per cent. of the treated animals in a shorter period of time—the virus gradually lost the power to produce recognisable horsesickness in horses. It did, however, retain the ability to "salt" or immunise horses into which it was injected. Horses immunised with the mouse-brain material proved to be immune either to natural infection or to experimental test with the virus, which regularly killed all susceptible animals into which it was injected. This was true only so long as the virulent virus and the attenuated or weakened virus were of the same strain, *i.e.*, were from the same original source.

Strains of virus from other sources (from various parts of the country) were found, which partly or completely broke down the immunity of animals vaccinated with a single strain of mouse-brain virus (hereafter called a vaccine strain to differentiate it from the natural strains encountered in the field). By combining a number of vaccine strains derived from the various natural strains at our disposal, it was possible to effect the complete immunisation of all animals against the natural strains. It thus became possible to issue a vaccine with reasonable hope of meeting with a fair measure of success.

Vaccine was first issued in considerable amounts in 1934, and the reports and returns for the season 1934-35 showed that losses from horsesickness were few and far between. Hence the new vaccine was a great success. Since 1934 about 150,000

doses of vaccine have been issued, and the results have on the whole been astonishingly good. It is now possible to keep horses in parts of the country where, formerly, it was courting disaster to introduce them. Horse breeding is actually being carried on in some of those districts.

Occasional individual "breakdowns" are to be expected, for no method of immunisation in any known disease is perfect. It is known also that certain animals may fail to become immune. In some instances the losses from breakdowns in certain districts exceeded expectations and were considerably higher than the general average mortality from this cause. Investigation proved that the natural strains differed considerably from those from which the vaccine strains were derived. In all cases where such losses occurred, steps were taken to isolate and "fix" these strains and to produce vaccine strains that would serve as a protection against the new natural strains. Thus, several new strains have been fixed and incorporated in the vaccine. The original vaccine contained three more or less closely related strains derived from a somewhat limited area. The present vaccine includes strains isolated in various parts of the country and differ markedly from each other, so that the immunity produced is effective against a far greater range of natural strains.

As in previous years, vaccine is available from the first of June to the end of November, and horse owners are urged to send in their orders as early as possible to avoid disappointment. From the point of view of vaccine production, it is essential that the demand be spread to the greatest possible extent over the whole season in order to avoid the terrific strain on the mouse breeding entailed by confining production to the last two months. Such delay may be a major contributory factor in a possible breakdown in vaccine production. From the point of view of the horse owner it is advisable to immunise as early as possible, as it takes from three to four months for the vaccinated animal to become fully protected. By vaccinating early the farmer will not only benefit himself, but he will also facilitate the production of vaccine and prevent many other farmers from being disappointed.

The vaccine produces little or no reaction in the inoculated horses, but it is nevertheless advisable to keep the animals at rest for one month from the date of vaccination. In-foal mares and foals at foot may be vaccinated, but it is better not to vaccinate mares during the period 14 days prior to and 14 days after foaling. In the case of valuable animals yearly vaccination is advised, despite the fact that a high grade of immunity probably lasts for a number of years and, in many instances, may be lifelong. Annual vaccination is recommended, as new strains are still being incorporated in the vaccine.—(Union of South Africa, Department of Agricultural Press Service.)

CLEANLINESS

AIDS INSECT CONTROL

on Lands in Sheds, Stores and Farmsteads

An Experimental Pack for Virginia Tobacco.

By M. C. MOSSOP, M.Sc., Entomologist.

For some years the writer has made a point of emphasising to tobacco warehousemen and others the advisability, from the insect control point of view, of sealing tobacco bales that have a wrapping of paper. Virginia tobacco after passing through a re-conditioning machine, the temperatures in which free it of any living insect pests that may be present, is normally pressed into bales of about 220 lbs. The bales are wrapped in waterproof paper and then sewn up in hessian with as little delay as possible. If the paper covering is sealed and thereafter remains intact, there is practically no chance of infestation of the tobacco by insects.

Two serious drawbacks to this procedure are stated to be first, the difficulty of effective sealing, and secondly, the piercing and tearing of the paper by the use of hooks when handling the bales in dockyards and possibly in overseas warehouses. Even rough handling without hooks is liable to break corners of the bales and destroy the additional advantage derived from sealing. Once an opening is made in the paper, the tobacco is exposed to the attack of insect pests while *en route* overseas or in infested overseas warehouses where the bales may be stored until withdrawn for manufacturing purposes.

But these possible difficulties can be largely overcome if a pack now undergoing experiment in Salisbury proves successful and economical. Tests are being carried out by Messrs. Reid Rowland & Co., Salisbury, at the instance of the United Tobacco Cos. (South), Ltd., with a stoutly constructed corrugated cardboard carton which holds the regulation size bale of Virginia type tobacco.

The packed cartons have undergone very severe tests. They have been dropped from a height of about three feet

onto a brick floor; they have been rolled roughly down concrete ramps; and they have been capsized at full speed together with the barrows on which they were being trundled. They survived this severe man-handling satisfactorily, and protected the tobacco from injury.

Owing to the construction of the corrugated cardboard carton it is anticipated that it will be possible to stack the packages six or more high without subjecting the tobacco in the lower layers to any greater pressure than that to which it is subjected by the present practice of stacking four or five bales high. The almost complete absence of bulging of the carton should result in even distribution of weight over the carton below. Similarly, support of the carton above is extended to the four corners, and this support is not afforded by hessian bales.

Experimental use of the cartons was initiated with a view to effecting a general increase in efficiency, including a saving on scrap and waste tobacco during export, or during warehouse or factory storage. The nature of the hessian bale lends itself to the breakage of tobacco in ordinary handling, especially if the tobacco is inclined to be dry. The greater rigidity and more careful handling that is hoped to result from the corrugated cardboard carton pack is expected to effect a saving that will help to cover the additional cost. It is expected to find that cartons can be used more than once. In any case, if the saving effected by the reduction of scrap and waste is but approximated, the ease and simplicity of sealing and consequent reasonable insurance against insect attack will justify the adoption of the cartons, even if it is found after trial that they can be used once only.

Insect pests of stored products are known to chew their way out of the containers in which they have developed. They may ,in doing so, also chew their way into a neighbouring container that is in close contact. But they do not commonly chew their way from the open into a container, although their preferred food may be enclosed therein. In experiments with the Stored Tobacco Worm, *Ephestia elutella*, Hubn., and the Tobacco Beetle, *Lasioderma serricorne*, F., some years ago, the writer starved the insects to death by confining them in a vessel together with sealed

paper bags containing suitable tobacco in which they could normally feed and breed. None entered the bags, nor did their progeny. Some of the bags were made of tobacco baling paper and others of ordinary brown paper. Similarly, two bales wrapped in baling paper and sealed with glue were exposed to infestation for over a year, and did not become infested. In parallel experiments with Maize Weevil, *Calandra oryzae, L.*, the beetles starved to death outside of cloth bags containing weevil-free maize, and no progeny emerged from the maize. Cloth coverings, however, would not protect tobacco bales unless the cloth were very fine and strong, as eggs of tobacco pests could be deposited on the bales, and the resulting young larvae force their way in. Further, tearing of such covers would be difficult to avoid.

From the above observations it will be seen that sealed cardboard cartons would offer good protection against pests of stored tobacco, provided the tobacco is packed free of pests or is freed of pests by fumigation after packing. As most of our Virginia tobacco for export, and indeed for local manufacture, now passes through a conditioning process that includes temperatures lethal to all stages of tobacco pests, and as very little time elapses between conditioning and baling, it is practically certain that the tobacco is packed pest-free.

The tests so far carried out with corrugated cardboard cartons in the Reid Rowland Warehouse have led to the following tentative conclusions:—

1. The cartons are expected to reduce the formation of scrap and waste to an extent as yet undetermined.
2. The cartons containing tobacco can withstand a considerable amount of rough handling.
3. The stacked cartons can be made to occupy less floor space than hessian bales containing the same weight of tobacco.
4. The compactness of a stack of tobacco in cartons is expected to result in the better retention of condition in the tobacco.
5. Better maturing of tobacco *en route* overseas and in storage is hoped to be obtained by the use of cartons.

6. The cartons can be easily, speedily and completely sealed by means of gummed strip paper, and this is not a separate operation, but a continuation of the closing operation.
7. Broken cartons can be easily and speedily mended by means of gummed paper.
8. The cartons, especially those comprising the bottom layer of a stack, are more difficult to handle than bales, but automatically receive more careful handling.
9. Cartons are more expensive than paper and hessian, but can probably be returned flat from overseas for further use.
10. A carton weighs 9 lbs., *i.e.*, nearly twice as much as the equivalent amount of paper and hessian.
11. After being pressed, tobacco must remain clamped under pressure for four hours before being placed in the carton.
12. Difficulties in sampling may arise.

If cartons prove to be successful, a further use might add to their advantages. Those growers who, contrary to advice, find it necessary to retain a certain amount of tobacco on the farm can pack the required tobacco in cartons and seal them. As a precautionary measure, the tobacco can then be easily and cheaply fumigated by injecting, by means of a hypodermic syringe, probably about 5 to 10 c.c. of carbon bisulphide. The small hole made by the needle can be sealed easily and effectively with gummed paper. Indeed, this type of treatment, using a different fumigant, could very likely be developed for use as a routine measure in connection with all consignments leaving a warehouse should this step at any time become necessary, and for use in factory storerooms. The rate of penetration of gases through corrugated cardboard would have to be studied before positive recommendations could be made.

Other cartons, constructed of compressed cardboard, have been tried also, but these have already been found to be inferior to corrugated cardboard cartons.

Trial shipments of tobacco packed in cartons are to be made, and further developments are awaited with interest.

The Pot Planting of Eucalypts.

By Major G. R. WAKE, Vigila, Umvukwes.

This article refers to eucalypt planting in the Umvukwe district in north central Mashonaland, the soil being mainly a sandy loam, the average rainfall 35 inches and the altitude about 4,800 feet, roughly the same as Salisbury. Naturally, the problem of eucalypt planting varies according to the rainfall. Though 35 inches is ample enough if more or less evenly distributed throughout the year as in the Eastern districts,or if it is accompanied by "guti" or mist during the dry period as in the Midlands; its value is greatly decreased when, as in the Umvukwes, it all comes down in five months, ending abruptly in March or April, and is followed by a dry period of six months or more, sometimes without even a shower.

When the greater part of this tobacco district was opened up in 1925 and 1926, farmers were not long in realising that the countryside would be rapidly denuded of timber for fuel purposes, and efforts were soon made to plant eucalypts, but the results were most disappointing.

The "open root" system, understood to be entirely successful in the Eastern districts, was employed, but the problem was greatly complicated by the necessity of using all the labour on dull or wet days for planting out tobacco. Eucalypt planting was put off, and if no convenient opportunity occurred, was abandoned. Not much planting was done and the "stands" were usually very poor.

Some three years ago the Nyasaland pot planting method, as opposed to open root planting, was generally adopted. It is no exaggeration to say that the area under eucalypts all planted during the last three rainy seasons fully equals the area planted in the previous ten years.

It is here necessary to point out that the method of pricking out seedlings in petrol tins cut in half lengthways, as adopted by the Government nurseries, is not feasible in this district, for the very obvious reason that petrol is now obtained from pumps by those farmers living near a store, or is bought in drums to save expense. Such petrol or paraffin tins as find their way to a tobacco farm are of great value for carrying water to tobacco seedbeds, and are kept for this purpose. Nor can boxes be made owing to the high cost of timber. Moreover, if tins are used, the soil used must be a special mixture of antheap or clay, and great care must be taken when planting seedlings in the field, failing which the lateral roots will be disturbed and the plant die. This danger is eliminated when pots are used, and no skill is required to obtain a perfect "stand."

The Nyasaland pot is a cylinder made of "dagga" as used for slop bricks, about 6 inches long with an interior diameter of 2½ inches, and with no bottom. These are burnt sufficiently to be handled with ordinary care without breaking. The eucalypt seedlings are pricked out in the pots which are filled with ordinary sandy top soil, and when about six inches high the pots are cracked in several places and the eucalypt, pot and all, is planted out in the field. The lateral roots work their way through the cracks, and if the latter are large enough the plant makes a satisfactory growth.

Some farmers broadcast the seed over the pots when filled with soil, and then thin out surplus seedlings. Apart from the obvious waste of seed, the writer has found that this method was actually longer and more expensive than pricking out, because the labour of watering a large area of pots lasted twice as long. Attending for half the time to a very small area of seedbed where thousands of seedlings can be grown is not an expensive matter.

One "boy" can prick out hundreds of seedlings in a day, and the only care necessary is to avoid exposing the roots to the sun. To avoid losses in this way, the seedlings are put at once into a can of water as soon as pulled from the seedbeds, and then conveyed to the pots.

In order to avoid as much transport as possible, it is advisable to have the pot nursery close to or on the site of

the proposed plantation, provided of course that water is available. If the plantation is near water, the pots can be taken direct from the kiln to the nursery several hundred in one wagon load. When the time for planting out comes, they can be taken to the field in a wheelbarrow, or carried by hand, whichever is most convenient. The Nyasaland method of pot construction is admittedly clumsy and wasteful. It necessitates the complete destruction of all the pots every season. In addition, there is always the danger of the check to the growth of the plant in the field, or its loss, if the pots are not suitably cracked and the lateral roots fail to break through.

The writer, who in pre-war days has watched hundreds of geraniums being bedded out, and their pots being used again and again, has very successfully used a cone shaped pot, from which the eucalypt is removed without the soil being disturbed and the pot used again. When the seedling is six to eight inches high, it becomes sufficiently root bound to allow of its removal from the pot without any soil breaking away. Ordinary sandy loam from a vlei is used, and the plant well watered before removal. The sides of the pot are gently tapped and the plant is pushed out from the bottom.

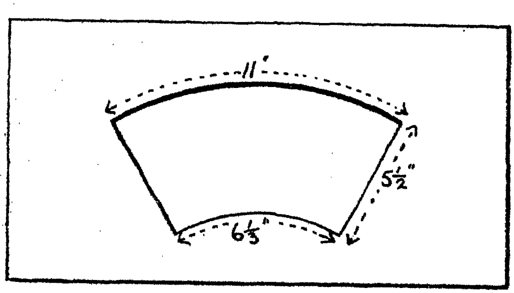


Fig. 1.

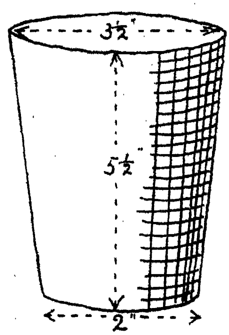


Fig. 2.

The size of the cone shaped pot is 5½ inches high, and its internal diameter is 3½ inches at the top and 2 inches at the base. The pot has no bottom.

The pot mould is easily made by cutting out a piece of paper the internal dimensions of the pot and placing it flat on a half inch plank made of ceiling boards, or the top of a

petrol box. This piece is cut out and the mould is now put on a plank covered with a piece of cloth (fig. 1). The mould is filled in the ordinary way with dagga made from two parts anthill to one part sand. The mould is lifted off and the dagga, which is the correct dimension of the pot, is wrapped round a block of wood the interior size and shape of the pot. The cloth is peeled off, and the side sealed with the fingers. The pot is then slipped off the block and put out to dry (fig. 2). The dagga should be made stiff enough to handle, but no difficulty has been found here. After drying in the sun, the pots are placed on their sides in layers two or three pots deep in a trench, the bottom of which is filled with a layer of wood or mealie cobs. Alternate layers of wood and pots are put in the trench until it is filled. The most convenient size of the trench is 5 or 6 feet wide and 3 to 4 feet deep and any length required. A fire is lit at one end and in 24 hours all the fuel is consumed and the pots properly burnt. They should become red hot for this purpose. The writer has found that this method of planting eucalypts, which can be done on a hot day when tobacco planting is not possible, is by far the most economical in time and labour, and if done early on in the season to allow the eucalypts to get established, losses due to bad planting are nil.

The making of this improved type of pot is not costly. One man to mix the dagga and two men with moulds can, with a little practice, turn out 500 to 600 pots in a day, which should last for years.

NOTE BY THE DIVISION OF FORESTRY.

The need for augmenting indigenous timber supplies in many tobacco growing areas is of such importance that tree-planting should be considered as an integral part of farming operations, and requiring its due measure of care and attention.

Any planting method which is economical and ensures a satisfactory establishment is to be commended. In areas of favourable rainfall the planting of open-rooted seedlings direct from nursery beds can be carried out successfully at

small cost if it is done during dull or rainy weather and provided proper care is taken (*a*) in lifting the plants in such a way as to cause the minimum of damage to the roots, and (*b*) transporting the plants in a sloppy mixture to ensure that the roots are exposed to the air for as short a time as possible. Carelessness in these respects usually means that the plants are dead before being planted out in their permanent sites.

Ball-planting of transplants from tins or trays (usually 25 to 30 transplants per half petrol tin or similar receptacle) is generally a safer method, especially with such trees as *Eucalyptus maculata*, *E. citriodora*, *Callitris calcarata*, *C. glauca*, *Pinus longifolia* and *P. canariensis*, because the roots are contained in a ball or cube of earth and thereby suffer little disturbance or exposure.

Pot planting is merely a modification of ball-planting, but it means that each tree is treated more as an individual, so that there is a tendency for planting to be more costly, particularly in the matter of transport from nursery to planting site.

For those tree growers who are unable to exercise adequate supervision of open-rooted plantings or who cannot obtain tins or trays for ball-planting, it is probable that pot planting is most likely to ensure a successful stand of trees.

Cleanliness Aids Insect Control
in Lands and Sheds, Stores and Farmsteads.

Humus and Witchweed.

By S. D. Timson, M.C., Assistant Agriculturist.

For some years the writer has been investigating the possibility that the addition of humus to the soil in the right form may influence the growth of witchweed (*striga lutea*). No scientific enquiry into the question has been possible, but some very striking results have been observed as the result of rough experiments carried out with the co-operation of farmers.

In one experiment directly observed by the writer this year the farmer applied to different areas of soil very severely infested with the parasite (*a*) dressings of compost, (*b*) a similar dressing of kraal manure. The area treated in each case was several acres in extent, and the adjoining land, which was untreated, served as controls. Both the treated and untreated areas received a dressing of phosphatic fertiliser.

The maize on the area treated with compost grew into a beautiful crop, which when it was well "in cob" the writer estimated would yield about 15 to 16 bags per acre. This estimate was confirmed by experienced farmers. The writer carefully examined this land, and found one group of three or four plants of witchweed. On the adjoining untreated land on both sides there was all the evidence of severe injury to the maize by witchweed, the crops being very stunted in growth and the estimated yield very low.

Later this untreated area was covered with witchweed (in the words of the farmer it was "a red carpet of witchweed") before the parasite was destroyed by cultivation.

In the case of the area treated with kraal manure the results were good, although the maize did not thrive so well, and a moderate sprinkling of witchweed was found through the field.

It was particularly impressive to note in the case of the compost-treated plot that on the side where the supply of compost gave out, the irregular boundary of the treated area

was clearly marked, not only by the striking improvement in the growth of the maize, but by the complete absence of witchweed. The compost used was made by placing maize and other crop wastes and dry grass under cattle in a kraal, and then managing them as compost.

No claim for this rough trial is made, of course, that it is proof that compost will control the parasite, but the results were so striking that the writer feels justified in urging other farmers to test the effect of applying compost at the rate of 8 to 10 tons per acre to severely infested soil in order to observe the effects for themselves. Untreated areas should be left on either side of the treated area for comparison.

A dressing of phosphatic fertiliser of 150 to 200 lbs. per acre should also be applied to both the area receiving compost and the adjoining untreated area.

The trial of applications of kraal manure is not suggested solely because the supply of this on the average farm is very limited, whereas compost can be made in very large quantities on any farm. The compost should be well rotted, and should have been made with the help of animal manure and, if possible, urine or urinated soil.

In another case reported to the writer in another district a similar though not so striking a result followed application of bat guano to maize on land infested with the parasite.

In a number of other cases observed in previous years applications of kraal manure have been noted as giving results similar to that reported above, but not so marked.

The problem of controlling this parasite as economically as possible is of such pressing importance that it is considered advisable to make the above suggestion (*i.e.*, that the effect of compost on witchweed be tested out by farmers at once) in order to avoid the delay of several years, which would be necessary to prove or disprove the matter scientifically.

It is hoped that as many farmers on infested farms as possible will try this, and that they will report the results to the writer. He would also be glad to inspect personally as many of such trials as he is able to, when the parasite is well above ground on the untreated areas.

Paspalum.—Paspalum established in rows on poor sandy wet vlei soil. Photographed October, 1936.

Rhodes Grass.—A crop of Rhodes grass hay ready for carting. A valuable aftermath for grazing was also obtained

Improved Pastures.

By S. D. Timson, M.C., Assistant Agriculturist.

PART I.—ESTABLISHMENT FROM SEED.

Foreword.—It is pleasing to be able to record that greatly increased interest is being evinced by farmers all over the Colony in the question of laying down improved summer pastures, both on dry land and on moisture-retaining soils.

Of the grasses which can be recommended for this purpose at present (with certain reservations to be discussed in a later section) only two can be established from seed obtainable commercially, namely, Rhodes Grass (*Chloris gayana*) and Common Paspalum (*Paspalum dilatatum*).

An increasing area of land is being laid down under these two grasses each year, and since very few farmers have had experience in sowing fine-seeded pasture grasses it is hoped that the following notes on the subject will be helpful.

A summary will be found at the end.

It must be borne in mind that the sowing of fine pasture grasses is a very different proposition to the planting of the other crops commonly grown in the Colony, since, for one thing, the finest tilth normally prepared for other crops is quite unsuitable, because the seedling grasses are very weak and small, and have not the power to push aside even small clods of earth in order to reach the surface. Moreover, their root systems for some weeks after germination are very weak and shallow, and it is therefore necessary to maintain the moisture in the soil very near the surface, and a very fine and also very firm tilth is requisite to ensure that the minute rootlets have intimate contact with the soil particles so as to enable them to obtain an adequate water and food supply.

The choice of suitable sites and soil will be dealt with in later sections of this article, and it is presumed that the farmer has made a correct choice and is preparing the field

for sowing the grass. If any are in doubt concerning their choice of soil and site they can obtain advice from the Department of Agriculture.

Rhodes Grass.—It is proposed first to make recommendations for this grass, and later to point out the differences in the requirements of Paspalum.

Rhodes grass is not so hardy as most of our native grasses and requires a higher level of soil fertility if a reasonable degree of permanence of a pasture is required. It is almost useless to sow this grass on badly worked out or eroded soil. It cannot thrive under such conditions, and the farmer's time and money will be wasted. It is very unlikely that a good stand of grass will be obtained under such conditions, and even if this is achieved the grass will weaken after a year or so; weeds and coarse grasses will then establish themselves; and the pasture will rapidly deteriorate.

In case farmers hesitate to establish Rhodes grass on land severely infested with witchweed it may be stated that this can be done with safety. Rhodes grass brings little or none of this parasite to the surface and thrives under such conditions. It is, however, of importance to ensure as pure a stand of the grass as possible by the growing of sunnhemp before seeding the grass and also mixed with the grass, and by sowing thickly (at least 8 lbs. per acre of the best seed) in order to exclude "wild" grasses, which may enable witchweed to seed down.

It is also desirable to state here that, except under irrigation, it is not advisable to lay down this grass in areas having a lower average rainfall than 25 inches per annum.

In areas having a lower rainfall than this it should only be tested on a small scale first, and then only if the farmer is prepared to give the pasture good treatment.

If complete success is aimed at then the farmer must be prepared to treat this grass as he would any other crop from which he expects profit, on the principle that "If you don't put something into the soil you cannot fairly expect to get a profitable return from it."

Growing the Seed.—One of the chief items of cost is the purchase of seed. This can be largely avoided by laying down a seed plot at the rate of one acre for every 10 to 12 acres which are to be sown in the second year.

Apply 6 to 8 wagon loads per acre of good compost or old kraal manure, and 300 lbs. per acre of rock and superphosphate. This should ensure good growth, and yield of seed. If no manure is available then at least 300 lbs. per acre of complete grass fertiliser should be applied.

Contour Ridging.—When the extremely fine seed-bed is prepared for the sowing of fine grasses, there is serious danger of severe soil erosion taking place before the grass is established if a heavy rain-storm falls in the interim, and most of the money put into the soil in the cost of preparing the seed-bed, and the applications of manure and fertiliser, and in the seed, may be lost.

It is therefore very advisable, before establishing any considerable acreage of Rhodes grass, to protect the soil from erosion by contour ridges. These should be of a type which will allow the mowing machine to work over them without difficulty.

After the grass is well established these ridges will still serve a very useful purpose in checking soil erosion, and also in conserving moisture in the soil by checking rapid run-off of the storm water.

Contour-Strip Sowing.—The contour ridge is the most satisfactory and the only really reliable method for general use in preventing severe soil erosion before the grass is established, but an alternative method suggested by the writer elsewhere* eliminates the cost of making ridges, and it should be satisfactory on moderate slopes, although contour ridges are the only real solution of the problem on steep slopes.

On the system suggested the whole field is sown before the rains with sunnhemp at the rate of 40 lbs. per acre and dressed with phosphatic fertiliser, if this is necessary to ensure a good growth.

R.A.J.*, **February, 1937.—Natural Protection from Soil Erosion.

In January strips of the sunnhemp 30 to 50 yards wide are mown on the contours, which should be marked by poles tall enough to be visible above the sunnhemp, and the alternating strips of sunnhemp are left to mature for seed. The mown sunnhemp is made into hay if weather is suitable, and if not it may be made into compost or kraal manure in narrow temporary kraals on the headlands, and this may be returned to the land the following year.

The Rhodes grass is then sown on these strips after preparing a seed-bed, and the remaining strips may be left to seed or may be made into compost, and are sown with the grass the following spring.

If the soil is too sticky to permit this system being adopted, or if rain interferes with the hay making, the crop can be reaped for seed and the construction of contour ridges carried out during the winter. If heavy rain spoils the hay in the making, the sunnhemp will still be valuable for turning into compost or manure. Where virgin soil is being laid down to improved pasture this contour-strip method of sowing should be of particular value. In this case, too, if the soil is fertile there will not be any need to sow sunnhemp and strips of the natural veldt can be left between the strips sown to the grass and the strips of veldt ploughed and sown in the following season.

Providing Humus and Destroying Weeds.—An ample supply of humus or organic matter in the soil and a weed-free seed-bed are two of the most important matters that must be assured. Both these can be provided for by the growing of a crop of sunnhemp on the field in the first season. After ploughing and harrowing the land thoroughly Somerset sunnhemp should be broadcasted at the rate of at least 40 lbs. of seed per acre.

If the fertility of the soil is low a strong growth of the crop must be ensured by the application of two hundred pounds per acre of rock and superphosphate or, if available potash is lacking in the soil, as is often the case with sandy soils, then the same dressing of potassic super may be used, or a dressing of 30 to 50 lbs. of muriate of potash per acre may be given in addition to the phosphatic fertiliser mentioned above.

Proper ploughing of the land is necessary at this stage to ensure that the sunnhemp will not suffer unduly from drought, and also because no further ploughing will be done before the grass is sown.

The sunnhemp should be utilised either for seed or for making compost as advised in Section III. of Departmental Bulletin No. 1048, or for hay. If the former is decided on sowing may conveniently be done just prior to the rains in October or early November.

If it is to be turned into hay then sowing should be delayed until the end of December or early January, so that good hay-making weather may be reasonably well assured in the latter half of March, when the crop is in full flower *at the latest*, or about $2\frac{1}{2}$ months old.

It may be pointed out here that the more mature stubble of sunnhemp left when the crop is mown for compost at 16 to 18 weeks or reaped for seed will be of greater benefit to the Rhodes grass than the immature stubble left when the crop is cut for hay.

The ploughing under of the crop of sunnhemp is not advised, since the effect of this on the following Rhodes grass is too dependent on climatic factors, and in certain circumstances may have a definitely bad effect on it through the loss of minerals, especially nitrates, due to leaching by late rains, or early rains the following spring.

It may also make it very difficult to obtain the very firm seed-bed, which is so necessary for ensuring a good stand of the grass.

If the sunnhemp is plouged under in early March, as it should be in order to ensure that it will be so well rotted as not to cause an unduly loose seed-bed for grass, then the loss of much of the nitrogen from the soil by leaching by the early rains in the following summer is inevitable.

If on the other hand it is ploughed under later in order to prevent this loss of nitrates then it will cause a loose open condition of the seed-bed, which is fatal to a proper establishment of the grass.

Preparation of the Seed-bed.—After removal of the top growth of the sunnhemp the soil should not be disturbed until it has dried out. If the stubble is worked whilst the soil is still moist there is a danger, almost amounting to certainty, that the rotting of the stubble will take place too soon; the insoluble organic nitrogen contained in it will then be converted into the soluble nitrate form which may be leached and lost from the soil by late rains, or by the early rains in the spring of the following season, before the young Rhodes grass can take it up.

It is of great importance that this supply of nitrate should be available to the young grass, as successful establishment of the latter is very largely dependent on an ample supply of available nitrogen, particularly in the early stages of growth.

So long as the sunnhemp stubble is not disturbed until the soil has dried out the danger of this loss of nitrate taking place is greatly reduced, since the micro-organisms which rot down the stubble, require an ample supply of moisture for their work, as well as an ample supply of air (the latter being brought about by opening up the soil by ploughing or other cultivation). This supply of moisture will not normally be available to them through the winter.

At any time during the winter, after the soil has dried out, the stubble may be thoroughly disc-harrowed and then repeatedly spike-harrowed, and finally chain-harrowed until as fine a tilth (a "garden tilth"), and also as firm a tilth as possible is obtained. If the soil is of such a type that it becomes too hard to work after drying out then the preparation of the seed-bed should be done just before the soil dries out, or be postponed until the spring rains arrive. If the latter is necessary, then the preparation of the seed-bed must be carried out as quickly as possible so as to allow of early sowing in order to avoid the leaching of nitrates, and other available plant foods, before the Rhodes grass can pick them up.

For the same reason if, owing to the claims of other crops, it is not possible to sow the grass until the latter half of December, then the sunnhemp stubble should not be worked until just before seeding, or, if a crop of weeds has to be dealt with, until this is necessary.

If there is reason to think that leaching of the nitrates from the soil has taken place, it will be advisable to apply a dressing of a nitrogenous fertiliser, such as ammonium sulphate, just prior to seeding, and perhaps another similar dressing when the grass is well established. It is obviously desirable to avoid this additional expense if possible by timely preparation of the seed-bed and sowing.

The proper preparation of the seed-bed is of the greatest impórtance. The seed of the grass is very small, and the seedlings very delicate with very fine rootlets. The seed must not be covered deeply or the seedlings will fail to reach the surface. If the tilth is not really fine, it will not be possible to cover much of the seed thinly enough. *It must be remembered that a covering of soil of more than half an inch over the seed may prevent its growth.*

Furthermore, in order to obtain their food supply the rootlets of the seedlings must be in intimate contact with fine particles of soil, and if the tilth is not fine or if the seed-bed is not firm, this cannot take place properly, and a poor stand will result, owing to many seedlings dying off. A firm seed-bed is also of importance to ensure that moisture is retained in the top half inch of soil in which the grass seeds germinate and grow. If the seed-bed is loose and open this can only happen under exceptionally favourable rainfall following seeding.

Type of Seed-bed Required.—The type of seed-bed to aim at, therefore, is one in which the soil beneath the surface is thoroughly compact and firm, with two or three inches on the surface of finely pulverised soil, in a thoroughly friable condition, and yet not loose and open. Such a surface tilth is commonly called a "garden tilth" in this Colony and feels firm under foot and is easy to walk over.

It is readily obtained on a sunnhemp stubble by first thoroughly disc-harrowing several times and by repeatedly spring-tooth harrowing, and spike or drag-harrowing. The work should be finished off by the use of a chain harrow followed by a roller to consolidate the surface soil. The best type of roller for the work is a ridged or Cambridge roller, since this leaves the soil in small ridges and furrows, which is ideal for

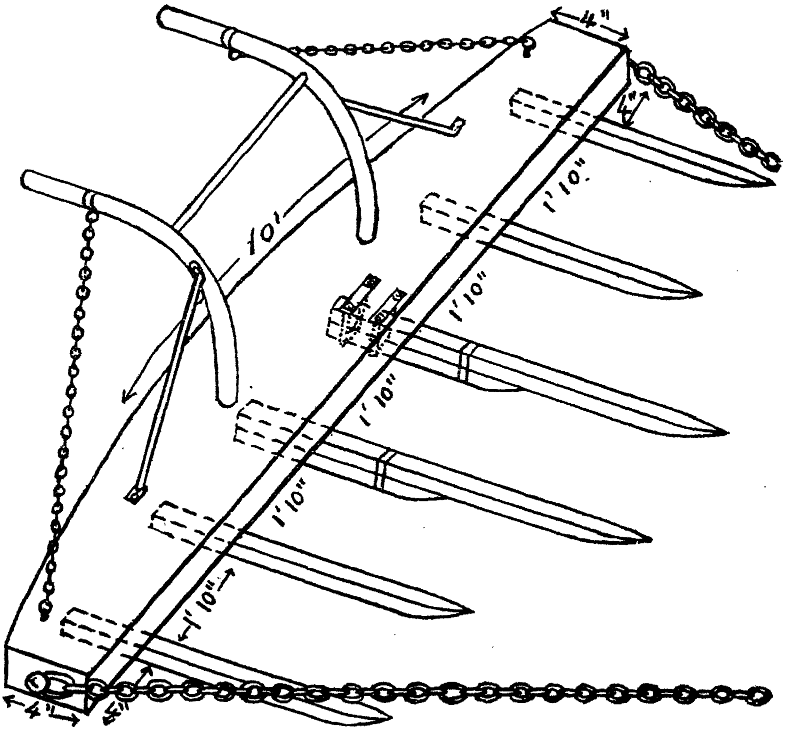
seeding; a smooth roller will, however, serve very well, and such a roller can be cheaply made on the farm from a good straight gum tree. If any considerable acreage is being seeded to grass, then a roller becomes a necessity. A good seed-bed can be prepared by the use of a disc-harrow and drag-harrow only, but spring-tooth and chain harrows will make the work easier and better. The chain harrow is particularly valuable in giving a fine finish to the surface tilth, and particularly in compacting the top 3 inches of soil.

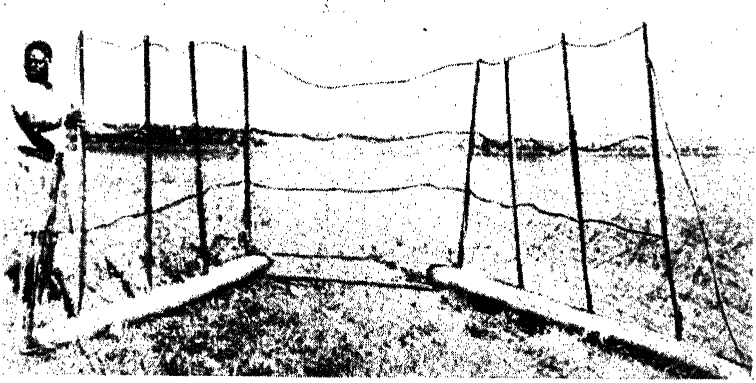
The writer is well aware that a fairly satisfactory stand of Rhodes grass has been obtained with far less preparation of the soil than advised above, but this cannot be expected except when very favourable rainfall follows for some time after seeding, and germination.

If conditions are unfavourable following germination, however, then the faults in preparation of the seed-bed soon become apparent, and the majority of the seedlings may die, and in extreme cases a complete failure may be recorded. This is a very expensive business for the farmer, even if he has grown his own seed. Favourable rainfall conditions for seeding fine grasses are the exception rather than the rule in Rhodesia, and therefore the farmer who sows Rhodes grass without adequate preparation of the seed-bed is gambling too heavily, and if failure results he usually has only himself to blame.

A very common cause of failure is due to too deeply covering the seed, owing to the tilth being too coarse.

One very important reason for endeavouring to obtain as good an original stand of grass as possible is that weeds are much less troublesome. Furthermore, if a full crop of hay is to be obtained in the first season, the stand must be thick. When only a thin stand is obtained, although the ground may be completely covered eventually, since Rhodes grass is of a strongly creeping habit, yet the grass has to waste much time in covering the ground before it commences its upward growth, and unnecessary loss of soil, and with it manure and fertiliser, will take place owing to the delay in the grass covering the ground.





Hay Sweep and Hay Drag.—Such simple time and labour-saving implements should be available on every farm. They can be made on the farm very cheaply.

Seeding and Covering the Seed.—The seed is fine and light, and is more easily sown if it is mixed with several times its bulk of superphosphate, or rock and superphosphate if it is to be sown immediately, and if these fertilisers are being applied. Alternatively it may be mixed with fine dry sand or sifted soil.

Always divide the seed into equal portions, and sow half one way across the field and then sow the other half in a direction at right angles to the first. This goes far to ensure an even distribution of the seed.

The seed may be broadcasted by hand or by a hand-broadcasting machine of the "Cahoon" type, or by seed barrow. For this Colony the Cahoon type broadcaster is probably the most satisfactory method. Sowing should preferably be done on a quiet day, since a gusty wind will cause uneven distribution of the seed. *In covering the seed the ideal to aim at is to cover as large a proportion of the seed as possible with a thin covering of soil about $\frac{1}{8}$ to $\frac{1}{4}$ inch deep. Very little seed covered by more than $\frac{1}{2}$ inch of soil will reach the surface and survive on heavy loam soils.*

The best method of covering the seed is probably to finish the seed-bed with a stroke of the Cambridge roller, which leaves the surface in small ridges and furrows; then sow the seed and cover simply by rolling with a smooth roller across the line of the first rolling. This goes far to ensure the fine but even covering of the seed, which is so desirable.

If only a Cambridge roller is available, this can be used for covering the seed also. If only a smooth roller is available, roll the seed-bed before sowing, and cover the seed with a brush harrow, and then roll again once or twice. Two rollings with a light roller in different directions is better than one rolling with a heavy roller.

A brush harrow is simply made by tying the fine branches of a tree to the top of a spike harrow and then turning it upside down. Where no roller is available, it is best to wait for rain to consolidate the seed-bed before sowing, then sow, and cover with a brush harrow. If whilst waiting for rain a crop of weeds appears, this must be destroyed by a stroke of the drag harrow before seeding.

No farmer should be or need be without a roller, since it can be cheaply improvised from a straight round section of a gum tree. Although the writer has not seen it put into practice, it would appear to be feasible to make a Cambridge roller on the farm by screwing narrow bands of corrugated iron round a suitable section of a gum tree. Such a roller would probably need to be carted to the field to avoid the flattening of the corrugations.

Considerable stress has been laid on the use of a roller in seeding grass, because it is of great importance for helping to ensure a steady supply of moisture and food to the very delicate seedlings during the critical stage whilst they are establishing themselves.

Mixed Seeding with Sunnhemp.—Since a heavy storm of rain of several inches in a few hours, or even in an hour, may fall at any time after the seed-bed has been prepared, there is therefore the danger that serious loss may be incurred before the grass is established owing to the washing away of the surface soil, carrying the seed and fertiliser with it. This damage may be severe under these conditions even where the land is contour-ridged.

A method of seeding, which helps to prevent this to a considerable extent, is by a mixed sowing with sunnhemp. The sunnhemp (Somerset strain) is first sown in two portions as recommended for sowing the grass, so as to ensure as even a stand as possible. It is then covered in the usual way, and the roller is then put over the land and the grass is then seeded as advised above and the work finished by rolling. The two crops should not be sown together, since one or the other will then be covered too deeply, or too lightly.

A light seeding of sunnhemp should be employed; of about 12 lbs. per acre.

When the sunnhemp has reached the flowering stage, or just before, it is mown for hay, and under favourable conditions the Rhodes grass then grows out into a hay crop. If the seasonal rains stop early a crop of Rhodes grass hay may not be obtained, but at least good grazing should be secured.

Even if good hay making weather is not available at the right time and the sunnhemp has to be left for some weeks

the grass will not be harmed, though its growth will be checked of course.

If the sunnhemp hay is spoilt by rain it will still not be wasted, since it is of great value for turning into compost by putting it under the feet of cattle for a few weeks in a kraal. The farmer should, however, provide himself with the simple time and labour-saving implements which are described in Bulletin No. 1048 and can be made on the farm for a few pounds. These are illustrated here.

The sunnhemp makes rapid growth, and as soon as it is above ground it forms an extra insurance against excessive soil wash, and as soon as it is a few inches high the soil is comparatively safe.

Additional considerable advantages are claimed by the writer for this system as follows:—

If a firm crust is formed by rain on the surface of the soil after seeding the Rhodes grass will have great difficulty in breaking through it, and in some cases this has resulted in a very inferior "stand." Where sunnhemp is sown with it this crop helps to break up the crust, and so let the grass through. The tender seedlings of the grass are easily scorched by sun and wind when they are just above ground, and the sunnhemp provides shade and shelter for them.

Further, by seeding with sunnhemp the grass benefits eventually by the humus and nitrogen left in the soil in the stubble of the sunnhemp, and an adequate supply of humus in the soil is of even greater importance in laying down permanent pasture, or a long term ley, than with annual crops, since it is not at present possible to get it well down into the soil after the grass is established.

The decay of the roots of the sunnhemp, too, leaves channels in the soil which should assist materially in maintaining the good drainage and aeration, which are of such importance for the healthy growth of the grass roots.

The mixed sowing of Rhodes grass and sunnhemp has been tested with success by a number of farmers, and it is of interest to record that in one instance a heavy green manuring seeding of the sunnhemp was made by error; but the Rhodes

grass, nevertheless, made a perfect stand and gave excellent grazing in the autumn and a beautiful crop of hay the following year.

The grass grew to a height of about nine inches before the removal of this heavy covering of sunnhemp, which was cut and made into hay when it was well past the "full flowering" stage. Weeds were, of course, very effectively controlled.

The advantages claimed for this system of laying down Rhodes grass may be summed up as follows:—

(1) The farmer gets two crops of sunnhemp hay, or one crop of hay and a crop of seed or compost whilst the grass is being established, and the Rhodes grass gets two sunnhemp stubbles to supply it with the all-important humus and nitrogen it requires.

(2) The second sowing of sunnhemp materially assists to prevent loss due to serious soil erosion.

(3) The sunnhemp serves as a mother crop for the grass and protects it from wind and sun in the seeding stage.

(4) If a hard crust forms on the seed-bed after rain the sunnhemp will break this and help the grass to come through it.

(5) Both crops of sunnhemp help greatly to control weeds.

(6) The very firm and fine seed-bed so essential for grass is rapidly, easily and cheaply made.

Rate of Seeding.—The rate of seeding necessary with Rhodes grass depends, of course, on the quantity of the seed, but also very much on the quality of the seed-bed prepared as well as other factors; but it is most economical in the long run to use a rate of seeding on the heavy side so as to ensure a good stand in the first year as free as possible from weeds. This ensures a heavy hay crop or good grazing the first year and less trouble in controlling weeds, and less soil erosion. If the germination capacity of the seed is only about 15 per cent., sow 12 to 16 lbs. per acre. With good seed 5 to 6 lbs. per acre may suffice, but unless all conditions are very favourable the writer advises a seeding rate of 8 lbs. per acre even with good seed.

Manure and Fertiliser.—On red and chocolate loam soils, which are in good "heart," Rhodes grass sown on a sunnhemp stubble should not require any other fertiliser to establish it than the phosphatic fertiliser applied to the sunnhemp crop.

On heavy soils of a lower level of fertility, and on sandy soils, it may be advisable to apply 50 to 100 lbs. per acre of sulphate of ammonia to the sunnhemp stubble before preparing the seed-bed for the grass to ensure good establishment of the grass and a good hay crop or grazing in the first season. Alternatively this fertiliser can be applied after the grass is a few inches high, in which case nitrochalk can be used instead of sulphate of ammonia, on acid soils.

If the grass is not sown on a sunnhemp stubble and the soil is not in good "heart," a dressing of 5 to 8 tons per acre of compost or well rotted kraal manure should be ploughed under, and in addition a dressing of 200 to 300 lbs. per acre of rock and superphosphate applied. If manure and compost are not available, the soil should be dressed with at least 200 to 300 lbs. per acre of a complete fertiliser containing 5 to 10 per cent. of nitrogen.

On poor, or impoverished soils, or on badly eroded soils, do not plant the grass at all, as it is a waste of time and money. Such soils must first be reclaimed to a good level of fertility by proper treatment, including contour ridging.

Irrigated Rhodes Grass.—It is not sufficiently appreciated that Rhodes grass gives very heavy yields of green fodder, or hay, of high quality on good loam soil under irrigation. Under such conditions, and with good treatment, this grass will yield three heavy crops of fine quality hay per year, or high quality grazing for 9 to 10 months in the year.

On one estate in this Colony this grass has out-yielded every fodder crop so far tried, and in parts of India has out-yielded all other pastures, including lucerne. As an irrigated crop it has great possibilities, since besides being such a high yielder it is easily established, and the hay is much more easily won without loss than from lucerne, which latter always suffers considerable loss in making into hay.

But if this grass is to occupy high-priced land under irrigation, and be expected to yield produce for 9 to 10 months

in the year, it must receive good treatment, and it is advisable to establish it on a sunnhemp stubble, and in addition to give it a dressing of 8 to 10 tons or more per acre of compost or kraal manure, or, failing the latter, 300 to 400 lbs. of grass fertiliser containing 10 per cent. nitrogen.

The sunnhemp should be sown at 40 to 50 lbs. per acre. It can be sown in August after frosts are past and reaped for hay or compost in October; and the Rhodes grass can then be sown on the stubble in November.

Perennial red clover may be sown with the Rhodes grass, and care is required to cover this seed very lightly, and it will probably be found best to sow it after the Rhodes grass, and cover both together. Roll the seed-bed with a Cambridge roller before seeding, and cover by rolling with a smooth roller.

Eight pounds of the best seed of Rhodes grass and 4 lbs. of red clover per acre should be sown.

The best type of red clover to use is the New Zealand Government certified Giant Colonial Cowgrass. The New Zealand Montgomery red clover is equally good, and perhaps superior, but the seed is at present expensive. These clovers are permanent and should last at least 5 or 6 years, and even up to 10 years, and yield the highest quality fodder, or green forage. They will re-seed themselves if allowed to do so. If red clover is to be sown with the grass then a heavy dressing of rock and superphosphate should be ploughed under before seeding the sunnhemp, and a dressing of 300 to 500 lbs. per acre should be applied. This will ensure a strong growth of sunnhemp, and later of the clover, and the latter will then supply nitrogen obtained from the air both for itself and for the Rhodes grass, thus making it unnecessary to apply expensive nitrogenous fertilisers to the grass.

The clover seed must be inoculated with a culture of the proper bacteria before sowing, so as to ensure thorough inoculation of the roots.

Red clover does not thrive on acid soils, and this condition must therefore be corrected by dressings of lime applied before ploughing. Few of the red and chocolate loam soils are more than slightly acid, but sandy soils frequently are.

If the Rhodes grass is to be pastured at times then Alsike clover should be included in the mixture, and 2 lbs. of this clover and 2 lbs. of red clover per acre will be a suitable seeding. Alsike clover withstands greater acidity of the soil than red clover.

Wild white clover, or New Zealand white clover, are not suitable for sowing with Rhodes grass, which is grown for hay or green forage, but when the grass is to be used largely for pasture, and the pasture will be carefully managed, these clovers should be included in the mixture, 2 lbs. of seed per acre of either being used in the mixture, with 2 lbs. of each of the other clovers. White clover prefers a neutral or slightly alkaline soil.

Paspalum dilatatum.—Although this grass is very much hardier than Rhodes grass, and will persist on soils of such low fertility as would be useless for that grass, nevertheless it will pay the farmers to treat this grass well, both when establishing it and in after years, since it is a palatable grass, which has a high feeding value when grown on fertile soil, and will give grazing in autumn and early spring and a good "green bite" in the winter where the soil retains moisture.

It will give its best returns on the fertile heavy black vlei soils of the maize belt, and most of these soils would be much more profitably employed as paspalum pastures than in the production of maize, since they only yield good returns of the latter crop in dry seasons.

It will, however, give better results on the poor sandy wet vleis than any other grass, with the possible exception of swamp couch and *Acroceras macrum*.

Paspalum is, of course, suited best by much moisture soil conditions than is Rhodes grass, and will grow and thrive on soils which are far too wet for obtaining the best results with the latter grass. The system of establishing Rhodes grass, advised above, therefore, may require modifying to some extent when applied to the laying down of paspalum, but should be followed as far as local soil conditions allow.

The preparatory crop of sunnhemp can, however, usually be grown even on very wet vlei soils, if a heavy rate of seeding is used (40 to 60 lbs. per acre) and, what is most important,

if the seed is sown early before the seasonal rains commence. It should also always be assisted with phosphate fertilisers.

It will not usually be possible to cut the sunnhemp crop for hay owing to the wet condition of the soil, but a crop of seed may be reaped, which should materially assist to pay for the cost of establishing the grass. One experienced farmer has informed the writer that he gets his best yield of seed from sunnhemp when it is grown on the heavy black vlei soils, which only give a good crop of maize in a dry year, and he now grows his seed crop on such soil. A good dressing of phosphatic fertiliser should be ploughed under before sowing the sunnhemp, to assist its growth, and the yield of seed. The rock and superphosphate mixture, at the rate of 150 to 250 lbs. per acre, is suitable.

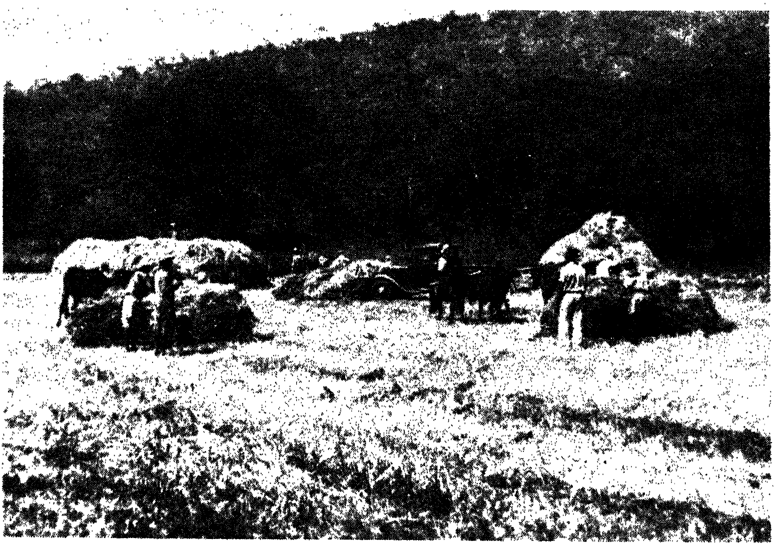
In reaping the sunnhemp for seed, a short stubble only should be left, since ploughing in a long stubble will tend to cause looseness of the seed-bed, and therefore a poor "stand." The mixed seeding of this grass with a light seeding (12 lbs. to 14 lbs. per acre) of sunnhemp can also be recommended, but it will usually be impossible to reap the latter for hay, and it should then be left to mature and yield a seed crop. It will thus help to pay for the cost of laying down the grass; assist in controlling weeds, and improve the fertility of the soil.

The paspalum is slow in establishing itself and cannot be expected to provide much, if any, grazing in the first year.

The Seed-bed and Seeding Rate.—It will pay to prepare a really good seed-bed as for Rhodes grass, and this should be ready before the seasonal rains, so that seeding may be carried out before the soil becomes too moist. This is particularly important on the really wet vleis, since otherwise seeding will have to be postponed until too late to give real success.

It should be borne in mind that a warm soil is important for obtaining a good germination, and several months of warm weather are required after germination to ensure good establishment of this grass.

Paspalum can be covered in the same way as Rhodes grass, but the roller must be used with discretion on the heavy black vlei soils.



Hay-making Scene.—Hay-making on Somerset Farm at Concession. A Hosier motor-car hay sweep and two small ox-drawn sweeps in use.

The seeding rate per acre advised is 8 to 10 lbs. of the best imported Australian seed. Less than this should not be used, and more (up to 15 lbs. per acre) should be used if rapid establishment and exclusion of weeds is desired.

Cheap locally-produced seed should never be used, and the best quality is known as "hand-shaken, machine dressed" seed in Australia. As far as is known no seed of this quality is marketed in Africa, and it will certainly pay the farmer to import it himself. This quality of seed at present costs about 9d. per lb. in sterling currency in Australia at the present rate of exchange (roughly 25 per cent. in our favour). The names of reliable seedsmen in Australia can be obtained from this Department. The ordinary "imported" Australian seed sold in the Union of South Africa is sold at approximately 7d. per lb. for large orders (100 lbs. and over).

Investigation here and in the Union indicated that the seed has a very low germination capacity when it is new, which improves on keeping. Seed at least one year old should therefore be purchased if possible.

This may account for a few cases on record in the Colony of paspalum seed failing to germinate the first year, but germinating the following summer.

It never pays to economise on the price of seed. Only the best is worth sowing.

Mixtures of Rhodes and Paspalum.—Paspalum is rather slow in establishing itself, and where the soil is not so waterlogged as to make the growing of Rhodes grass impossible, a few pounds (4 to 5) of the latter can very profitably be sown with the paspalum. It will help to cover the ground quickly and so keep out weeds and prevent erosion, and it will give excellent grazing or hay for the first two or three years, when the paspalum will gradually overcome it, and form the permanent pasture.

If the acidity of the soil is first reduced by suitable applications of lime (usually about 1 to $1\frac{1}{2}$ tons per acre will suffice) Rhodes grass will grow quite well for a year or two even on very wet sandy vleis, as has been demonstrated at the Rusapi Pasture Experiment Station. The paspalum sown with it is now, however, gaining the upper hand, and will probably entirely replace it in a further year or two.

This Mixture Suitable for the Eastern Border.—This mixture should be of particular value on the large areas of sandy moisture retaining soils, which exist on the Eastern borders of the Colony, both on the hills as well as in the valleys. These soils (both those derived from granite and those derived from quartzites) are much more fertile than the sandy loams and sandy vlei soils of the rest of the Colony, and both Rhodes grass and paspalum thrive on them, the heavy rainfall of this area also being favourable to both grasses.

Although neither of these grasses are frost resistant (the Rhodes grass being more sensitive than the paspalum) yet they will together give a pasture which will yield grazing on such soils for the greater part of the year, usually 9 to 10 months. During the present mild winter the writer has found paspalum green and happy at elevations as high as 6,000 to 7,000 feet in June, and again in August.

Seeding Rates.—This mixture can be strongly recommended for this area, and suitable proportions will be 4-5 lbs. of Rhodes grass to 8 lbs. of *Paspalum dilatatum*. These soils can be ploughed at any time of the year and the requisite fine and firm seed-bed can therefore be prepared during the winter, and seeding can commence in November with the first seasonal rains, or even earlier where the moisture supply in the soil is ample, and if a roller is used to bring the moisture to the surface and keep it there; but later sowing is safer.

If the hill-tops with moderate slopes are sown first to this mixture the paspalum will tend to spread by seed to the lower and steeper slopes, which in many cases are too steep for cultivation, though it will be found that the entry of the self-sown paspalum seed into the soil can be assisted by the use of a pasture harrow of the "sunblade" type.

These two grasses can also be strongly recommended for sowing by themselves, when the Rhodes grass should give two heavy crops of palatable and nutritious hay and excellent grazing.

Farmers in this area are strongly advised to push on the establishment of these grasses on the Eastern border, both as a mixture, which is the best for pastures, and in pure sowings of each. The Rhodes grass will give heavy crops of hay for

winter feed both for sheep and cattle, but owing to the heavy rainfall it is particularly advisable to be equipped with the simple time-saving implements such as hay rakes, sweeps and drags, so as to be able to take advantage of short breaks in the rain for hay making, and at the same time in order to economise labour, which is never plentiful in this area.

Rhodes grass seed can be cheaply grown on the farm and paspalum seed is reasonably cheap to buy.

In this area the prevention of soil erosion would appear to be of greater importance than elsewhere, and contour ridging should be done before sowing large areas to pastures.

Alternately contour-strip sowing should be the rule as already suggested, strips or virgin veld being left alternating with the prepared strips to prevent excessive erosion, and the latter being cultivated and sown in the following season. If the strips are not wider than twenty to thirty yards the danger of severe wash (on the sandy soils at least) should not be serious.

Early sowing of these grasses in late September and October should be experimented with (on the moisture retaining soils only) advantage being taken of the rains which may be expected in those months. If this is found satisfactory, and the writer thinks it will be, then the danger of soil erosion will be greatly reduced if the mixture of Rhodes and paspalum is sown, since the former will soon establish itself and hold the soil in place when the heavy seasonal rains arrive. If it is found that the Rhodes grass is too slow in growth to do this, then the sowing of 10 to 12 lbs. per acre of sunnhemp with the grasses should be tried, which can be cut for hay or the making of compost.

Whichever method is used it must be strongly emphasised that satisfactory results cannot be expected unless a proper clean and firm seed-bed is prepared.

In writing the above the writer has chiefly had in mind the sandy moisture-retaining soils of the Eastern border. Rhodes grass can also be strongly recommended for the heavier red soils of the district, but on such soils paspalum cannot be

expected to give autumn and spring grazing, except in the valleys where the soil retains moisture. Both grasses can be expected to give excellent results in summer.

Finally, it should be mentioned that oats are an excellent preparatory crop to precede improved pastures on the moisture-retaining soils, and this practice can be strongly advised when the farmer is not in a hurry to establish the grass.

At those levels below 5,500 ft. above sea level sunnhemp could profitably be sown for hay (40 lbs. of seed per acre) in January, with 75 lbs. per acre of double superphosphate, reaped at the end of March, and followed by either oats for grazing or green forage, and the latter followed by the grasses sown in the spring. This treatment will mellow virgin soil for the reception of the improved pastures, and at the same time give the farmer a valuable return for his trouble.

It will be best to mix the double superphosphate with an equal bulk of dry sandy soil, to make even distribution easier.

Summary.—1. Lay down Rhodes grass only on soil in good "heart." It is useless to sow it on badly worked out and eroded soil.

2. For economy and experience, grow the seed on the farm. One acre of seed plot is required for 10 to 12 acres of pasture. Apply manure and fertiliser to the seed plot.

3. Do not sow large areas on sloping land which is not protected from soil erosion. The fine tilth required makes this very dangerous. Protect the soil with contour ridges, or sow on the contour-strip system.

4. After thoroughly ploughing, broadcast sunnhemp (Somerset strain) at 40 lbs. per acre. Apply phosphatic fertiliser, and on sandy soils potash also, if necessary to ensure a good growth of the crop.

5. Reap the sunnhemp for hay (in which case sowing should be done in late December or early January), or reap it for seed, or for making compost. In the latter case it can be sown before the rains. Do not plough under the sunnhemp.

6. Do not work the stubble until the top soil is dry, in order to avoid loss of nitrates from the soil.

7. Prepare a very fine and very firm seed-bed during the winter or early spring by disc-harrowing several times and subsequently harrowing repeatedly. Do not plough the land. Aim at obtaining a very firm "garden" tilth.

8. Finish off by rolling, preferably with a Cambridge roller. Don't roll a heavy soil when it is wet.

9. On soils which cannot be worked after drying out, the seed-bed must be prepared either just before the soil dries or with the first spring rains.

10. Mix the seed with dry soil or sand, or with rock and superphosphate for immediate sowing and divide into two equal portions, and sow half one way across the field and the other half at right angles to this direction to ensure even sowing.

11. Cover the seed by rolling if the land was rolled before seeding with a Cambridge roller or by means of a brush harrow. A covering of $\frac{1}{8}$ to $\frac{1}{4}$ inch of soil should be aimed at. Deeper covering than $\frac{1}{2}$ inch may be fatal on heavy soils. Sow 6 to 8 lbs. (preferably 8 lbs.) of the best seed per acre, and much more of poor seed.

12. Finally roll after seeding. Preferably roll twice in different directions with a light roller rather than once with a heavy roller.

13. If you have no roller, buy or make one on the farm.

14. It is preferable to sow sunnhemp at 12 lbs. per acre with the Rhodes grass. Sow and cover the sunnhemp, then roll and sow and cover the Rhodes grass. The sunnhemp protects the tender grass seedlings, helps them through a surface crust, helps to control weeds, and helps materially to prevent serious erosion. The stubble increases the humus supply in the soil and assists drainage and aeration.

15. Manure and fertiliser may be *necessary* on poor soil in poor "heart," but will be worth while even on good soils if the best results are aimed at.

16. Rhodes grass is an admirable pasture or hay crop under irrigation. Clovers assist the Rhodes grass and greatly increase palatability and feeding value. Three crops of fine hay and 9 to 10 months' grazing are obtainable.

17. *Paspalum dilatatum* is best adapted to moisture-retaining soils, but similar methods to those advised for laying down Rhodes grass are suitable with minor modifications.

18. The sunnhemp crop preceding this grass should usually be left to mature seed, as also the crop sown with the grass, unless it is possible to make hay.

19. The seeding rate advised for paspalum is 8 to 10 lbs. per acre of the best "hand-shaken machine dressed" Australian seed. Cheap local seed is not advised.

20. Sow with the first soaking rains in spring, before the soil is too wet.

21. A mixture of Rhodes grass and paspalum is recommended for certain conditions.

22. *For the Eastern border* short-grassed, hill farms, both grasses are strongly recommended for the sandy moisture-retaining soils. A mixture of the two is best for pasture, 4 lbs. of Rhodes grass being sown with 6-8 lbs. of paspalum. On such soils this mixture will give grazing for 9 to 10 months each year, and Rhodes grass will yield two hay crops and an aftermath for grazing or early spring grazing.

23. Of the two grasses only Rhodes grass is the more suitable for the dry soils of this area.

24. The hill-tops should be sown first and contour-ridged. The paspalum will spread down hill into the natural pasture.

25. Contour-strip sowing is advised, as an alternative to contour-ridging on the sandy virgin soils.

26.—Oats sown on a sunnhemp hay stubble in March are recommended as an excellent preparation for improved pastures on these moist soils at elevations below 5,500 feet above sea level.

Rhodesia Weather Bureau.

AUGUST, 1938.

Pressure.—Barometric pressure was generally about 1 mb. below the average for the month.

Temperature.—Mean temperatures were generally slightly above normal.

Rainfall.—Very little rain fell anywhere.

PRECIPITATION.

Station.	Inches.	Normal.	No. of Days.
Beitbridge...	Nil	0.07	—
Bindura...	0.07	0.03	2
Bulawayo	Nil	0.02	—
Chipinga	0.51	0.53	5
Enkeldoorn	0.02	0.04	1
Fort Victoria...	0.01	0.07	1
Gwaai Siding...	0.03	Nil	1
Gwanda...	Nil	0.06	—
Gwelo	Nil	0.07	—
Hartley	Nil	0.04	—
Inyanga	0.03	0.08	1
Marandellas	0.01	0.09	1
Miami	Nil	0.07	—
Mount Darwin	0.05	0.03	1
Mount Nuza...	2.34	0.86	6
Mtoko	0.04	0.05	2
New Year's Gift...	0.20	0.16	3
Nuanetsi	Nil	0.04	—
Plumtree	0.24	0.06	1

Station.	Inches.	Normal.	No. of Days.
Que Que	Nil	0.01	—
Rusape...	Nil	0.10	—
Salisbury...	Nil	0.12	—
Shabani	Nil	0.01	—
Sinoia	Nil	0.04	—
Sipolilo	Nil	0.07	—
Stapleford...	2.49	0.58	6
Umtali	0.22	0.21	3
Victoria Falls...	Nil	Nil	—
Wankie	0.01	Nil	1
Abercorn	Nil	—	—
Balovale	Nil	—	—
Broken Hill...	Nil	—	—
Chitambo	Nil	—	—
Fort Jameson	Nil	—	—
Fort Roseberry	Nil	—	—
Isoka	Nil	—	—
Kalomo	Nil	—	—
Kasama	Nil	—	—
Kasempa	Nil	—	—
Livingstone	Nil	—	—
Lundazi...	Nil	—	—
Lusaka	Nil	—	—
Mazubuka	Nil	—	—
Mongu	Nil	—	—
Mpika	Nil	—	—
Mporokoso	Nil	—	—
Mufulira	Nil	—	—
Mwinilunga	Nil	—	—
Ndola	Nil	—	—
Petauke	Nil	—	—
Senanga	Nil	—	—
Sesheke	Nil	—	—
Solwezi	Nil	—	—

AUGUST, 1938

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m.: Dry Bulb.	Wet Bulb.	Dew Point	Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute: Maximum	Date	Minimum	Date	Number of Days: Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
eitbridge...	1,500	62.8	55.3	49	7.5	79.8	51.3	65.6	94	30	42	1	7	3	...	...	66.3	969.8	885.9	970.0	2.6	...
indura...	3,700	59.3	50.9	43	7.8	76.0	47.7	61.9	87	31	38	16	1	5	..	1	62.3	895.4	885.1	...	1.7	...
ulawayo	4,393	59.5	48.5	36	10.0	74.1	48.4	61.3	88	30	42	7	1	7	...	...	61.0	872.9	884.7	871.3	1.9	9.7
hipinga	3,685	61.9	53.5	46	8.0	72.3	50.4	61.3	86	30	44	6	1	7	...	...	60.3	896.7	885.9	...	2.3	...
nkeldoorn	4,788	58.5	48.8	39	8.8	71.8	45.4	58.6	85	30	35	7	...	7	...	3	57.7	860.5	884.8	...	2.3	...
ort Victoria... ...	3,571	57.6	49.9	42	7.0	75.0	45.3	60.1	88	30	39	7	1	7	..	1	61.4	899.4	884.9	898.1	2.1	...
waai Siding... ...	3,278	59.8	49.6	39	9.4	83.1	43.9	63.5	95	30	37	6	14	1	...	6	...	908.1	884.0	...	1.9	...
wanda...	3,233	60.8	51.3	42	8.9	76.0	49.9	63.0	90	30	40	17	1	6	...	...	63.6	910.3	884.9	...	2.2	...
welo	4,629	59.3	49.5	39	8.9	73.2	46.5	59.9	85	30	40	7	...	7	...	...	60.7	865.6	884.9	...	2.1	...
artley...	3,879	59.8	49.9	40	9.0	77.0	45.1	61.0	87	30	36	7	2	6	...	2	61.9	889.0	884.3	...	1.2	...
nyanga...	5,503	59.9	48.3	35	10.6	69.2	44.1	56.6	81	30	38	23	...	14	...	5	56.1	...	...	...	1.5	...
arandellas	5,453	56.7	48.0	38	7.8	69.8	46.2	58.0	81	30	35	6	...	10	...	2	56.7	...	...	...	2.5	...
iami	4,090	60.8	51.6	43	8.8	75.0	46.7	60.9	88	31	38	6	1	6	...	1	59.7	881.7	883.7	879.9	0.4	...
t. Darwin	3,179	61.1	53.7	47	7.1	77.3	47.5	62.4	88	31	37	16	1	4	...	1	63.1	...	...	...	3.0	...
ount Nuza	6,668	49.7	43.9	37	4.7	57.4	43.2	50.3	69	17	33	6	...	31	...	7	48.4	803.5	885.0	...	3.8	...
toko	4,141	59.9	50.9	42	8.4	70.6	50.0	60.3	79	17	37	6	...	13	...	1	59.4	881.2	884.8	879.9	2.1	..
ew Year's Gift...	2,690	62.1	54.7	49	7.2	76.9	48.2	62.6	90	30	40	16	2	5	...	...	...	...	...	...	...	8.6
uanetsi	1,581	62.5	55.8	51	6.8	80.0	45.9	62.9	89	16	37	2	5	2	...	1	...	967.6	886.0	...	3.7	...

AUGUST, 1938 (continued)

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F																Pressure Millibars			Cloud Tenths	Sunshine Hours
		8-30 a.m.				Maximum	Minimum	Max. + Min. ÷ 2	Absolute				Number of Days				Mean of 24 hours	8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours		
		Dry Bulb.	Wet Bulb.	Dew Point	Vapour Press Deficit				Maximum	Date	Minimum	Date	Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°						
Plumtree	4,549	60.7	48.8	36	11.0	74.1	51.6	62.9	86	30	41	7	2	6	...	...	62.0	...	...	...	1.0	...
Que Que	3,999	59.9	50.5	41	8.7	76.6	48.2	62.4	87	30	40	7	1	5	...	...	62.7	885.5	884.7	883.7	2.0	...
Rusape	4,648	55.8	49.1	42	6.0	71.8	43.3	57.5	83	30	38	1	...	8	..	5	57.3	..	...	...	2.4	...
Salisbury	4,831	59.5	49.4	39	9.1	73.3	46.5	59.9	84	30	34	6	...	9	...	2	59.7	859.3	884.7	857.8	1.7	9.5
Shabani	3,131	61.9	52.0	43	9.4	76.6	49.2	62.9	90	30	42	1	2	7	...	...	62.9	...	...	...	1.9	...
Sinoia	3,795	59.8	51.6	44	7.8	78.4	43.1	60.7	90	31	34	16	3	3	...	5	60.3	...	...	...	1.4	...
Sipolilo	3,876	63.1	53.2	45	9.9	75.3	49.8	62.5	86	31	41	6	1	6	...	...	...	...	...	...	1.7	...
Stapleford	5,304	52.8	48.7	44	3.6	63.0	38.8	50.9	75	30	28	23	...	27	...	17	51.1	...	...	...	3.4	...
Umtali	3,672	59.6	53.2	47	6.1	74.3	49.1	61.7	86	30	41	6	1	6	...	...	60.1	896.9	885.7	895.5	2.6	...
Victoria Falls... ...	3,009	63.7	52.0	41	11.5	85.0	47.6	66.3	95	30	42	7	16	...	...	...	67.4	...	...	...	0.8	...
Wankie...	2,567	65.7	53.5	43	12.3	85.6	56.5	71.0	98	31	49	12	20	..	1	...	71.4	930.5	883.5	...	0.6	...
Abercorn	5,407	62.3	53.6	47	8.4	76.7	53.1	64.9	81	var.	47	7	...	3	...	...	...	838.0	881.7	...	0.3	...
Broken Hill	3,920	60.8	51.2	42	9.0	77.9	52.3	65.1	85	31	45	7	...	4	...	...	...	886.6	882.8	...	0.9	...
Chipili	3,900	60.7	54.4	49	6.1	87.8	49.0	65.9	89	17	45	31	11	...	...	...	...	...	...	...	...	...
Fort Jameson ...	3,620	65.3	56.2	49	9.4	82.5	56.4	69.4	91	18	48	6	9	...	...	...	...	890.5	884.0	...	0.5	...
Kasama...	4,700	61.4	54.2	48	7.1	79.6	52.1	65.8	84	var.	48	9	...	1	...	...	...	865.5	882.3	...	...	...
Kasempa	4,500	57.7	51.3	46	6.0	79.8	44.2	62.0	85	17	39	19	...	...	...	1	...	...	...	...	...	...
Livingstone	3,140	59.6	49.5	39	9.2	84.7	50.8	67.7	93	30	42	7	17	...	...	...	67.5	914.2	883.0	912.2	1.0	...
Lusaka	4,193	62.6	52.4	43	10.0	76.6	52.2	64.4	86	31	45	7	1	5	...	...	...	877.4	882.7	...	1.7	...
Mazabuka Res. ...	3,385	64.2	52.6	42	11.5	80.8	55.6	68.2	89	30	47	7	6	3	...	...	...	902.8	882.8	...	0.4	...
Mongu	3,475	65.0	54.3	45	9.8	39.5	56.2	72.9	98	31	49	11	25	...	...	...	...	898.8	881.5	...	0.0	...
Mpika	4,625	60.8	52.7	45	7.7	74.7	49.9	62.3	80	17	42	30	...	4	...	...	...	864.2	883.0	...	1.0	...
Mwinilunga	4,450	57.1	52.0	48	4.8	81.0	46.1	63.6	88	30	41	19	4	...	...	...	...	...	...	...	...	...
Ndola	4,140	59.5	51.7	45	7.3	80.4	49.7	65.0	86	31	42	7	1	1	...	...	...	877.4	882.4	...	0.7	...

Southern Rhodesia Veterinary Report.

JULY, 1938.

DISEASES.

No fresh outbreaks of scheduled diseases.

TUBERCULIN TEST.

Seventeen bulls were tested upon importation with negative results.

MALLEIN TEST.

Forty-five horses and 21 mules were tested upon entry. No reactions.

IMPORTATIONS.

From Union of South Africa.—Bulls 17, horses 45, mules 21, sheep 335, pigs 5.

From Bechuanaland Protectorate.—Sheep 988.

EXPORTATIONS.

To Union of South Africa.—Oxen 394, cows 20, horses 2.

To Northern Rhodesia.—Cows 8.

To Portuguese East Africa.—Oxen 95.

EXPORTATIONS.—MISCELLANEOUS.

To United Kingdom.—Chilled beef quarters, 6,650; frozen boned beef quarters, 1,689; kidneys, 233 lbs.; tongues, 167 lbs.; livers, 792 lbs.; hearts, 102 lbs.; tails, 71 lbs.; skirts, 62 lbs.; shanks, 76 lbs.

To Northern Rhodesia (in Cold Storage).—Pig carcases, 49.

To Congo Belge (in Cold Storage).—Beef carcases, 2,315; mutton carcases, 51; veal carcases, 28; salted boneless beef, 7,604 lbs.; skirts beef, 55 lbs.; chickens, 218¼ lbs.

Meat Products.—From Liebig's Factory—

To Union of South Africa.—Corned beef, 31,064 lbs.; beef fat, 24,000 lbs.; tongues, 6 lbs.; rolled beef, 3 lbs.

To United Kingdom.—Meat extract, 24,127 lbs.; beef powder, 69,798½ lbs.

To Portuguese East Africa.—Beef fat, 25,000 lbs.

B. A. Myhill,
Acting Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-38.

Monthly Report No. 69. August, 1938.

With the advent of warmer weather from the middle of the month onwards, greater activity has been displayed by wing swarms of the Red Locust (*Nomadacris septemfasciata*, Serv.).

Several swarms described as medium to large have been reported. Flying swarms have been reported from the districts of Lomagundi, Salisbury, Inyanga, Makoni, Umtali and Melsetter in Mashonaland. No reports have been received from Matabeleland.

Great variability has been observed in the direction of flight.

J. K. Chorley,
Acting Chief Entimologist.

THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.
(Assisted by the Staff of the Agricultural Department).

PUBLISHED MONTHLY.

Subscription: 5/- per annum; payable to the Accountant, Department of Agriculture, Salisbury.

VOL. XXXV.] NOVEMBER, 1938. [No. 11.

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, *Salisbury.*

Last Chance for Destruction of Maize Stalks.—Those maize growers who have not already done so should clean up their maize lands and vicinity as early as possible, and suitably dispose of the old stalks to prevent emergence of stalk-borer moths. The first moths are expected to emerge before the end of the month, and the peak of emergence is likely to occur early in December.

Shelling dumps should by now have been taken care of by composting, burning, or other suitable methods.

"Cleanliness Aids Insect Control."

Do You Read or Write Them?—The " Farmers' Wants " advertisements printed in our advertising pages are published at very low charges, because the more there are the more they are likely to attract attention. Do you read them?

The Government Game Reserve, Wankie.—As will be seen from the accompanying sketch plan of the Wankie Game Reserve, some 200 miles of road are now completed and further development is taking place. Steady progress is also being made in developing extended water supplies. Until a few years ago much of the game had to scatter towards the end of the dry season in search of water, but this has changed since boreholes and small dams have been provided. The number of game which can now be seen by visitors is increasing and the variety of game encountered is a surprise to all. During a visit to this Reserve in September the Minister of Agriculture and Lands, accompanied by the Secretary and the Conservator of Forests, saw not less than 389 head of game, comprising 16 different species, including buffalo, eland, elephant, giraffe, koodoo, ostrich, roan, sable, wildebeest, zebra, lion and jackal. This was all seen during a motor journey of 170 miles in the Reserve. The following morning Major H. G. Mundy saw 44 head of game of seven varieties during a short motor trip of ten miles.

No charge is made on entering the Reserve, nor for the use of rest huts, bedding, or the services of guides, etc. Visitors are the guests of the Southern Rhodesia Government and are expected to adhere strictly to the regulations laid down in the Government Notice No. 677 of 1934 and to the rules drafted by the authorities.

The regulations laid down in Government Notice No. 677, which particularly refer to casual visitors, are as follows:—

No person, other than a Government official in the exercise of his duties, shall, within a Reserve—

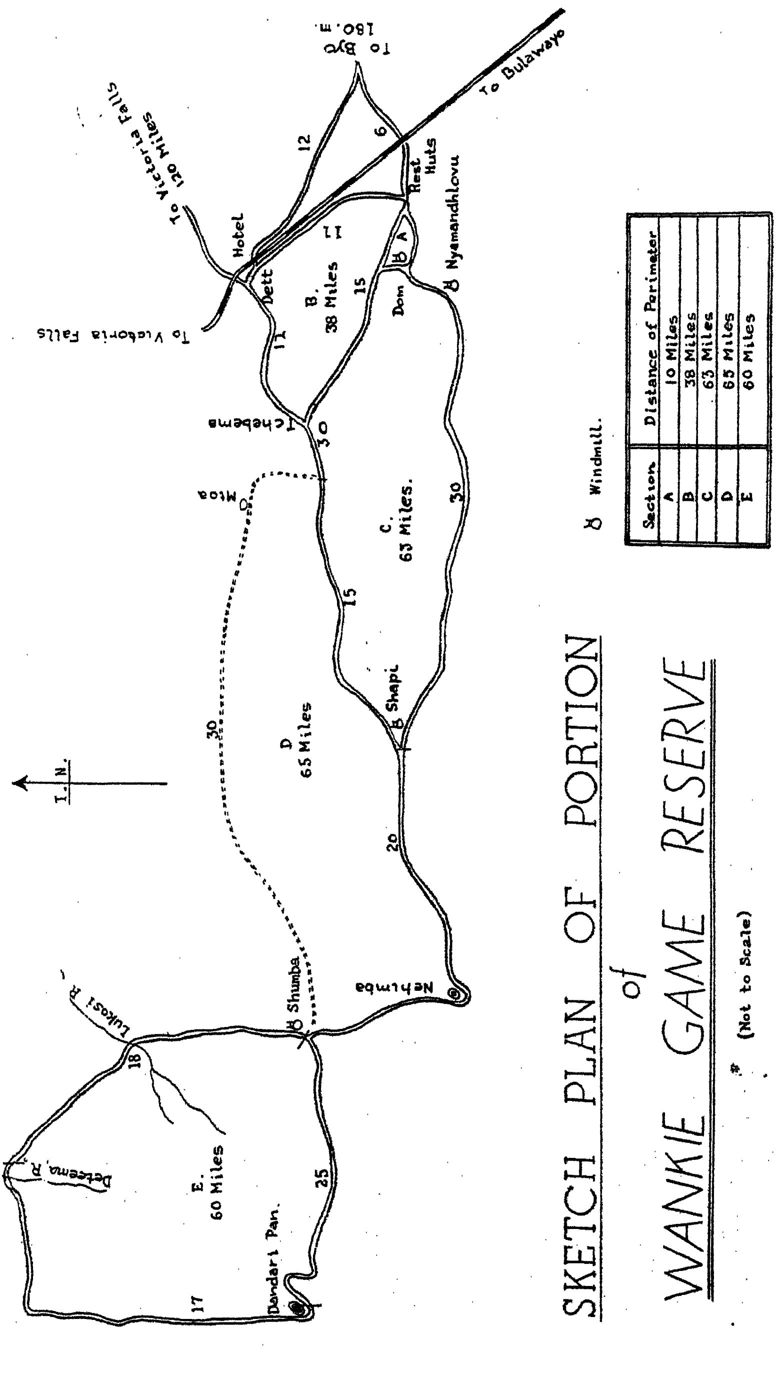
(*a*) encamp or reside;

(*b*) cut, destroy or remove any trees, shrubs, fruits or other vegetation or products of such reserve;

(*c*) light or kindle grass or other vegetation;

(*d*) carry or use firearms or other lethal weapons;

(*e*) use poison, nets, springs, gins, traps, snares or other contrivances for capturing or destroying birds and animals.



Section	Distance of Perimeter
A	10 Miles
B	38 Miles
C	63 Miles
D	65 Miles
E	60 Miles

SKETCH PLAN OF PORTION of WANKIE GAME RESERVE

(Not to Scale)

Visitors requiring to spend the night at either Shumba or Deteema Rest Camps should advise the Game Warden and take a native guide with them. No bedding is provided at these two camps and may not be taken from the main rest camp, where only a limited amount is available.

All visitors should take a native guide, if convenient; if not, they must report to the Game Warden, declare firearms, if any, and report to the gate attendant on leaving the Reserve.

Visitors must travel only by car, or obtain special permission from the Game Warden before using open lorries or other forms of transport, walk after game, or use hides for photography.

Persons must not leave their cars while in sight of game, and are requested PLEASE NOT to speed up when game attempts to cross the road. *Speed not to exceed 25 miles per hour at any time*, and keep on the roads.

All cars must be in the rest camp before one hour after sunset, and may not leave earlier than one hour before sunrise.

Visitors are requested NOT to picnic within half a mile of windmills or dams.

Please sign the visitors' book, either at the main rest camp or at the entrance gate.

The Game Warden will be obliged if visitors will mark on one of the lists supplied the numbers of the various animals seen, the distance travelled, and the date, and hand the list to the gate attendant or guide on leaving the Reserve.

The Rothamsted Experimental Station Report 1937, pp. 225. Price 2s. 6d. Obtainable from the Secretary.—Farmers and their technical advisers will find a great deal of useful information on crop production and the use of fertilisers in the present issue of the Rothamsted Report covering the activities of the Station during 1937.

The volume contains the full data relating to the numerous field experiments carried out at Rothamsted and many outside centres, and also valuable summaries of groups

of experiments dealing with special subjects. Although farmyard manure is by far our most important soil improver, its effects have not been measured nearly so frequently as those of artificials. All the available experiments with dung have been collected in the present report. They bring out its direct effect on potatoes, sugar beet and kale and its residual action on the following crops of cereals. An important point illustrated is the effect of the presence of dung on the action of artificial fertilisers. A further section sets out the main results of 107 fertiliser experiments on sugar beet carried out during the past four seasons on a uniform plan in all the important beet growing districts. Salt, one of the oldest of manures, has recently been carefully studied in its effects on sugar beet and mangolds. Its action has usually been very favourable on these crops and evidence on this point is collected from a number of centres. Under the present regulations for the sale of potatoes the size of the tubers is of considerable importance, and a review of the effects of manures on the proportion of ware potatoes is given. Liming experiments are also reported which show that in certain soils the effect of even a light application of chalk can persist throughout a long rotation.

A full account of the laboratory work is given, supplemented by abstracts of recent papers. In the Chemical Department the numerous field experiments have provided material for the study of analytical methods for estimating the manurial requirements of soils, and particular attention is being devoted to rapid methods of soil analysis. Perhaps one of the most interesting aspects of the biological work is the study of strains of the nodule organisms of leguminous plants. Some of these strains instead of being beneficial have been shown to be actually parasitic and in addition they are so aggressive that they can displace many of the strains that show the usual beneficial action on the plant. Fortunately certain strains have been discovered that are both beneficial and also capable of competing with the worthless strains.

The report contains a summary of twenty years' work in the Department of Plant Pathology in which the contributions relating to the study of wart disease of potatoes, take-all disease of wheat and the group of virus diseases are set out with full references.

Rosette Disease of Tobacco

FIELD OBSERVATIONS AND SUGGESTIONS FOR CONTROL.

By G. M. WICKENS, lately Plant Pathologist, Tobacco Research Station, Trelawney.

In the March, 1938, issue of this *Journal*(1) I briefly described a new disease of tobacco, generally known amongst growers as "Curly top," that in recent seasons has appeared in Southern Rhodesia and has locally caused considerable financial loss. The name "Curly top," although it describes well the general appearance of affected plants, is unfortunately rather too similar to "Leaf curl" (or "Curly leaf" as it is often called in Rhodesia), which is a quite distinct disease. For this and other reasons which need not be discussed here, I have named the new disease "Rosette." The general adoption of this name for the new disease under consideration would avoid confusion with "Leaf curl," and is to be most strongly recommended.

Since the publication of the article referred to above, Rosette disease has been studied in the field and further transmission experiments have been carried out. The results of the latter leave no reasonable doubt that the disease is caused by a virus that is carried from plant to plant by aphids* ("greenfly"). All attempts to transmit the disease mechanically, as tobacco mosaic is so readily spread, have failed. For all practical purposes it seems safe to assume that in the field aphids are the only agency by which Rosette can be carried from one plant to another.

Field Observations.—The occurrence of Rosette disease at the Tobacco Research Station provided an opportunity for detailed observations to be made on its distribution and rate of spread in the experimental fields of tobacco.

*This species has been provisionally identified as *Myzus persicae*, Sulz., a very common cosmopolitan species with an enormous number of host plants. Authoritative confirmation is still awaited.

Two phases of infection in the field can be readily distinguished: a localised phase, in which small distinct groups of affected plants are scattered here and there over the lands, and an epidemic phase in which the disease becomes generally distributed. Only the localised phase was observed at the Research Station; the destructive epidemic phase has been observed in the Trelawney and Umvukwes districts, and seems much more likely to occur in relatively late planted lands.

The source of initial infections in the tobacco lands must remain for the time being a matter for conjecture. Presumably, if the hypothesis of origin of the disease *de novo* within the plant be excluded, they arise as a result of migration into the tobacco of infective aphids from some wild or garden host, or from infected standover tobacco. The latter possibility does not seem very likely since, as a result of legislation aimed at the control of leaf curl disease, volunteer tobacco plants are now rarely seen in Rhodesia in the late winter months. It seems at present most probable that some wild or garden plant harbours the virus over the winter, and that it is from these that aphids pick up the virus and can then infect tobacco in the following season. Knowledge of the means of survival of the virus over the winter months is at present entirely lacking.

From these initial scattered centres of infection the disease spreads as a rule rather slowly—too slowly to do much damage. The most extensive spread from such a centre at the Research Station was in a plot of a spacing trial, with rows wide apart and the plants very close together within the row. In this plot, on 24th January, 19 plants showed symptoms of the disease, and from all other plots in the field the disease was absent. At this time wingless aphids were numerous in the affected plot, and a very few winged forms were seen. On 15th February 60 plants in this plot were affected, the spread being much more extensive along the rows than across them. On this latter date 17 plants, widely scattered over other plots in the same field, were also affected. One plot, adjoining the one with many diseased plants, accounted for five of these; the remaining 12 occurred singly in 12 different plots. By this time winged aphids were more common, and it is reasonable to suggest that these were

responsible for the new scattered centres of infection. Luckily all the tobacco on the Station was then so well developed as to have reached, or very nearly reached, the reaping stage, and it was then too late for any widespread infection that may well have occurred to do any material damage to the current crop.

Reports from growers indicate that the disease in its localised phase was common in most of the tobacco growing areas of Southern Rhodesia. Except for one instance where the disease assumed epidemic form in a fairly early planted land, all cases of severe epidemics were in late planted tobacco.

In the light of the observations made, it seems safe to assume that the localised phase of the disease arises as a result of wingless aphids, members of colonies developed on the initially rosetted plants, crawling to adjacent plants and infecting them in turn. In the early part of the season the tendency at the Research Station was for the production of almost exclusively wingless forms, and this undoubtedly was at least partly responsible for the restriction of the disease to rather small scattered areas. Later, more winged individuals were formed, and, presumably in consequence, numbers of fresh potential centres of infection occurred. It is suggested that the epidemic form of the disease arises from a widespread dissemination of winged infective aphids from colonies developed on rosetted plants—hence the commonly experienced higher incidence of Rosette in later plantings.

While the small amount of damage caused by the disease at the Research Station was due largely to the absence of appreciable numbers of winged aphids until all the tobacco was at least almost fully grown, another factor operated in restricting aphid development and therefore probably also extension of disease. Wherever aphids were present on the tobacco, Syrphid flies (Hover flies) of undetermined species were also much in evidence. Larvae of these flies were frequently observed in the act of devouring aphids, and both on caged plants and on observational plants in the field a single larva was found capable of completely clearing a plant of its established aphid colony within a very few days. Throughout the observational period one or more Syrphid larvae could be found on many of the plants that carried

established aphid colonies. Further, in the infested areas, many of the rosetted plants were found to be entirely free of aphids. On such plants Syrphid larvae or puparia were invariably found. But for the operation of this natural controlling factor it is probable that considerably more damage would have been done.

The present available knowledge of the nature, occurrence, distribution and spread of tobacco Rosette may be summarised as follows:—

1. The disease is caused by a virus that is transmitted from plant to plant by aphids (greenfly). Attempts to transmit it mechanically have all failed, so that, unlike tobacco mosaic, spread of Rosette by handling is most unlikely.

2. As far as I have been able to determine, the disease is not known in any other country. It was first recorded in Southern Rhodesia in season 1936-37, when in exceptionally late planted tobacco on one or two farms in the Umvukwes area it reached epidemic proportions. In the following season, aphid infestation was unusually severe, and Rosette disease was recorded from most of the tobacco growing districts. In most cases the damage recorded was slight. With one exception, all recorded cases of severe damage were in later plantings.

3. The means by which the virus survives the winter is as yet quite unknown. The method of over-wintering may well have a very important bearing on control, and in this connection investigation of the natural host range of the virus is urgently required.

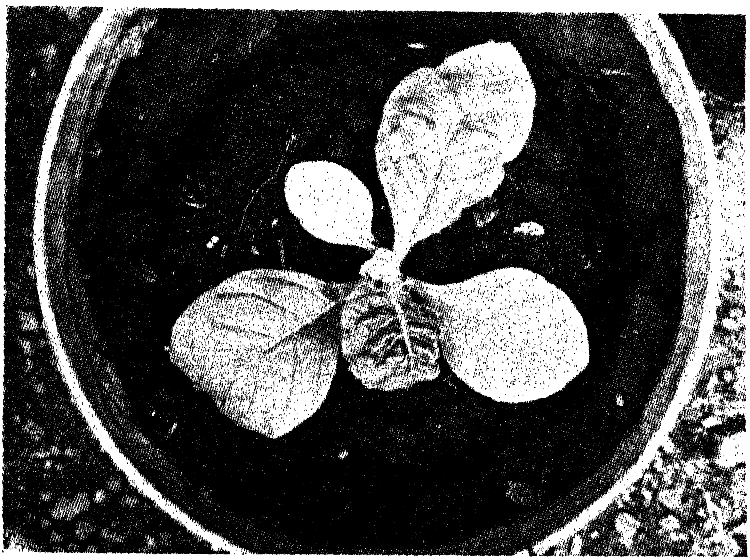
4. From the scattered initial infections in tobacco, the disease spreads to adjacent plants probably through the agency of wingless aphids from colonies established on the first rosetted plants. In this way the localised phase of the disease is set up. At the Research Station, and probably also elsewhere, the larvae of an undetermined Syrphid fly are believed to have considerably checked multiplication of the aphid vectors and hence also spread of the disease.

5. The epidemic phase seems to be dependent on the development of winged forms of the aphid vector among the colonies produced on diseased plants, which by their flight from plant to plant cause a general and widespread dissemination of the disease.

The Future Outlook.—It is, unfortunately, quite impossible, in the present state of our knowledge, to predict what will be the future course of tobacco Rosette. Its future severity will depend largely on three quite unpredictable factors: the extent of survival of the virus over the winter, the degree of opportunity of its early transmission to the new tobacco crop, and the amount of infestation and activity of the aphid vector in the tobacco crop. Many, no doubt, will consider the unusually heavy aphid infestation of last season a purely seasonal effect unlikely to be repeated, except very occasionally. But there are no grounds whatever for such a comforting belief. There is at present apparent no good reason why the disease should not become more and more widespread and destructive over a succession of seasons, unless every effort is made to check it. It would be folly at the present time to consider tobacco Rosette as other than a real and serious menace to the tobacco growing industry, and the following recommendations for controlling the disease should be assiduously practised by every grower.

Recommendations for Control.—1. *In Seed-beds.*—So far, no records have been received of the presence of Rosette in seed-beds before planting out. Nevertheless, transmission experiments have proved that seedlings are very susceptible, and the beds should be carefully examined at frequent intervals for aphids and for rosetted plants. If the former only are present, the infested beds should at once be sprayed with a nicotine sulphate spray or other nicotine preparation, and an even more careful watch kept for the appearance of Rosette. If the latter be present also, it would probably be most satisfactory, if the bed can be spared, to destroy every seedling and every aphid in the bed at once. If the bed cannot readily be spared, the following procedure, if carefully and thoroughly carried out, might eradicate the disease.

All rosetted seedlings should be carefully removed, taking great care that any greenfly on them are not shaken off, and



Young tobacco seedling experimentally infected with the virus of Rosette disease. Note leaf distortion, and the extreme stunting of the youngest leaf.

with their aphid colonies at once destroyed. The remaining seedlings should then be sprayed with a nicotine preparation. At frequent intervals thereafter very thorough inspections of the bed must be made, and roguing out of fresh infected seedlings with their aphid colonies and further nicotine sprayings applied as necessary.

In order to facilitate the detection of rosetted plants in seed-beds, a photograph is given of a young experimentally diseased seedling.

2. *In the Lands.*—At this point it may be emphasised that the impression held by some growers, that rosetted plants can grow out of the disease, is entirely erroneous. It is true that, after remaining in the rosette stage for some time, the infected plant usually resumes some sort of growth, but invariably the later formed leaves are extremely small and distorted. Except for any leaves worth curing that may have developed before the plant becomes infected, a rosetted plant is utterly valueless and incurable. There can therefore be no justification for leaving, in seed-beds or in lands, plants rosetted at such an early stage of growth that they do not bear, and never can bear, leaves of commercial value.

In the early stages of growth in the lands, therefore, frequent inspections and roguings should be made as advocated for seed-beds, in order to check as far as possible general dissemination of the disease. As before, care should be taken not to scatter the aphid populations on the rogued out plants—as far as possible the greenfly should be destroyed as well.

When the plants have reached the stage of bearing reapable leaves, roguing may well cease, so long as it is judged that the late infections do not constitute a source of danger to other later planted crops near by. If late infections are relatively few, winged greenfly are at all common, and there are promising later planted lands on the farm, then continuation of roguing would probably be well worth while. But when all crops have reached the stage at which infection can cause little material loss, further roguing can result in no financial benefit as far as the current season's crop is concerned. (It should be borne in mind that it might be found

to exert a powerful effect on the severity of disease in the following season, but unless and until evidence be obtained that this be more than a theoretical possibility, advocation of roguing involving the sacrifice of valuable leaf is hardly justifiable on this score alone.)

This is not to say that the presence of disease in plants bearing reapable leaves should be altogether disregarded. All that I have suggested is that there is at present no need for the sacrifice of valuable leaf unless the circumstances are such that other valuable crops are threatened. As soon as possible after leaves of any value have been reaped, the infected plants should, if time permits, be removed and destroyed. If, owing to pressure of reaping operations, this cannot be done at once, all old stalks should be uprooted from any land, in which Rosette has occurred, as soon as possible after reaping has finished.

There remains to consider the possibility of controlling the aphid vector in the lands. Unfortunately my experiments with spraying in the field have led me to the conclusion that, on most farms at any rate, large scale spraying operations of sufficient thoroughness effectively to control general and severe aphid infestation are at present impracticable. Unfortunately also large scale dusting, otherwise a reasonably practical proposition, seems to be ruled out on the score of the hitherto very high cost of nicotine dusts in Southern Rhodesia. The method is, however, perhaps worthy of trial. But spraying, if difficulties of water supply and carrying are not too great, or otherwise dusting of small areas of local infestation, would be well worth trying immediately after removal of rosetted plants, as suggested for seed-beds.

Deliberately I have refrained from making suggestions as to types and strengths of nicotine applications for greenfly control, times and methods of application, and so on. With regard to such details the Entomological Branch is much more qualified to advise, and to them accordingly I leave the task.

I have already mentioned that serious epidemic outbreaks seem more likely to occur in late planted lands. Where Rosette disease is present in the earlier plantings, and more particularly in districts where epidemics have previously occurred,

the grower takes a considerable risk in spending time and money on an exceptionally late planting. Under such circumstances he would be better advised to devote his time and energies to getting the most out of what is already planted.

It is all too easy for a Plant Pathologist, in making recommendations for control of a disease, to fall into the error of putting forward impracticable counsels of perfection. A common effect of this is complete disregard by growers of all the suggestions made, including those that are thoroughly practical. With this in mind, I have restricted my recommendations to operations that I know to be practicable for any grower with sufficient available labour and a determination to keep this new disease within bounds should it threaten again. If any grower, through leaving in seed-beds or in lands useless rosetted plants, suffers financial loss from later spread of the disease, he can have only himself to blame.

REFERENCE.

(1) Wickens, G. M.—A new and serious disease of Tobacco in Southern Rhodesia. Preliminary note. *Rhod. Agric. Journ.* XXXV., 3 March, 1938.

Cost of fattening Bullocks of various ages in Matabeleland.

By A. E. Romyn and C. A. Murray.

General.—Broadly speaking there is a market in the United Kingdom for most grades of chilled beef and it is a matter of much practical importance to determine what quality of chilled beef will in the long run yield the largest nett return to the producer in this Colony. The problem in its various aspects has been under investigation at the Rhodes Matopo Estate for the last four years and certain of the tentative conclusions we have arrived at are summarised in this article.

The natural veld is the cheapest feed available, but experience has shown that cattle in this Colony raised on grass alone do not get fat enough to reach the standard of quality (finish) required in the better grades of chilled beef until over the desired age for chilling. It has been found essential to supplement the natural grazing at certain stages of the animal's growth and at certain periods of the year. It has become, therefore, a matter of great practical importance, especially in Matabeleland, where the bulk of the export cattle is found, to find out the minimum amount of supplementary feeding which will produce a satisfactory carcase for export and maintain at the same time such a balance between the quality of the product and the cost of production as will return the largest nett revenue to the producer.

It is hardly necessary to emphasise that in searching for this information there are many related problems to be solved. It is necessary, for instance, to find out what the primary deficiencies in the natural pastures are, how these can be most cheaply made good and at what periods of the animal's life the assistance is most effective. These problems are under investigation now, but in this article we have summarised only

the information which has been obtained during the last four years on the total amount of supplementary feed necessary to produce market bullocks of different ages and qualities.

The important question of the possibility of improving the natural pasture, or the use of cultivated pastures, has not been touched on here, chiefly because the use of supplementary feed is an easier line of attack in the parts of the country concerned and also because we require more information on the management and reaction of natural pastures before one can draw definite conclusions as to their proper treatment.

History of the Export of Chilled Beef from Southern Rhodesia.—The earliest consignments of chilled beef exported from this Colony consisted of prime five to six years old oxen, mostly from the low veld, fattened entirely on the natural grazing. It was felt from the start, however, that not only was this type of bullock too old for a discriminating market but also that it was not an economic proposition to keep cattle to such an age before sale. An early development in the production of export steers was therefore to take $4\frac{1}{2}$ and $5\frac{1}{2}$ year old cattle, a year or so younger than the first type, which were sufficiently heavy for the purpose and fatten these for a period of two to four months previous to export. These four and five year old fattened bullocks sold well, but Murray (Bulletin No. 989 of the Department of Agriculture) soon showed, however, that by feeding a small quantity of a protein supplement in the winter months to the young stock in addition to the natural grazing it was possible to reduce this age from $4\frac{1}{2}$-$5\frac{1}{2}$ years to 3-$3\frac{1}{2}$ years without any loss of weight on the carcase. The 3-$3\frac{1}{2}$ year chiller then became the accepted standard of excellence for the ordinary run of chilled beef exported.

It is possible, however, to go further and to produce marketable steers at $1\frac{1}{2}$ and $2\frac{1}{2}$ years by using sufficient supplementary feed. Meat at this stage is more tender than that of older cattle of equal quality and normally sells for a higher price overseas. Consequently it was decided to determine whether the extra price realised on this younger type of beef would compensate for the extra cost involved in its production.

Plan of the Experiment.—Fattened steers of these younger ages are not produced in the Colony on a commercial basis

at present. There was consequently no local experience to guide us as to the quantity of feed necessary to produce the types of bullocks required. A general theoretic weight curve which the animal could be expected to follow so as to make the desired weights at the desired ages was therefore drawn up. An estimate was then made of the amounts of feed at the different times of the year which would be necessary to secure the increases in weight shown on this curve. The animals selected were fed accordingly and adjustments made in the amount of feed as the experiment progressed, whenever the rate of growth fell below the desired increases. In practice the rations work out satisfactorily, but it will be noted later that to ensure the continuous rate of gain in live weight necessary, comparatively little use could be made of the natural grazing for the 2½ year old steers and still less for the 1½ year old baby beeves. An account of the treatment of the various groups of steers is given in the following sections of this article. The data in regard to the 3½ and 4½-5½ year old steers have already been published in Departmental bulletins, though not from the aspect here considered.

The bullocks in all the various lots were fed as far as possible to the same degree of finish, *i.e.*, until from inspection on the hoof it was considered that they would grade a good average "Imperial"—the highest grade of the chilled beef exported at the time. The carcase tests showed that the baby beeves were fed to a rather higher finish than the other three lots which were very comparable. All the cattle were slaughtered and exported through the Rhodesian Export & Cold Storage Co., Bulawayo.

The breeding of the different lots of bullocks was not altogether similar but is in keeping with the general practice in the Colony to bring on "improved cattle" more rapidly than "ranching stock." In all cases the sires were well bred bulls of the imported beef breeds. The dams of the two older groups of bullocks were, however, of the crossbred or Grade Africander type, while those of the two younger groups were generally high grade cows of the imported beef breeds. It is considered, however, that in the case of these experiments differences in the plant of nutrition were of much greater importance than differences in breed or type.

RESULTS.

Group 1. Marketed at 5 years (4½-5½) of Age.—The data for this plane of feeding is taken from Bulletins Nos. 1024, 1053 and 1062 of the Department of Agriculture. The steers concerned were good grade ranch bred steers 4½-5½ years of age in medium condition and weighing somewhat under 1,000 lbs. liveweight when put into the fattening pens. These bullocks represent the typical good ranch product of the Colony at the present stage and were actually purchased from ranching companies. They did not carry sufficient flesh to kill as chillers when put into the pens and were fattened on various commercial rations in two-three months. Previous to the time they were put into the fattening pens neither they nor their dams had ever received any feed other than the natural grazing.

Group 2. Market at 3½ Years.—The data for this group of steers has been taken from Bulletins Nos. 989 and 1030 of the Department of Agriculture. These cattle were Grade Shorthorn or Herefords purchased as weaners (young yearlings) from ranches or extensive cattle farmers, and carried through two winters at the Government Experimental Farm, Bulawayo, on veld grazing with some supplementary protein feed during the winter months. The actual rations used were either peanut cake 1-1½ lbs. or 4-6 lbs. cowpea hay, or 1 lb. peanut cake plus 1-3 lbs. maize meal plus 2-5 lbs. silage per day. The cattle were fed these rations for a period of from 5-6 months each winter. During the summer they had veld grazing only, which was not limited. This grazing, as in other cases, was mostly on granite sand veld. They were ready for fattening at 3-3½ years of age and were fattened off on ordinary commercial rations in a period of somewhat less than three months.

This plane of feeding is easily attainable by any cattle farmer who can grow or purchase a protein supplement. The usual plan in the southern end of the Colony is for the feeder to grow at least the necessary legume hay and silage required for winter maintenance and fattening, and purchase the necessary concentrate, commonly maize, inyouti or kaffir corn.

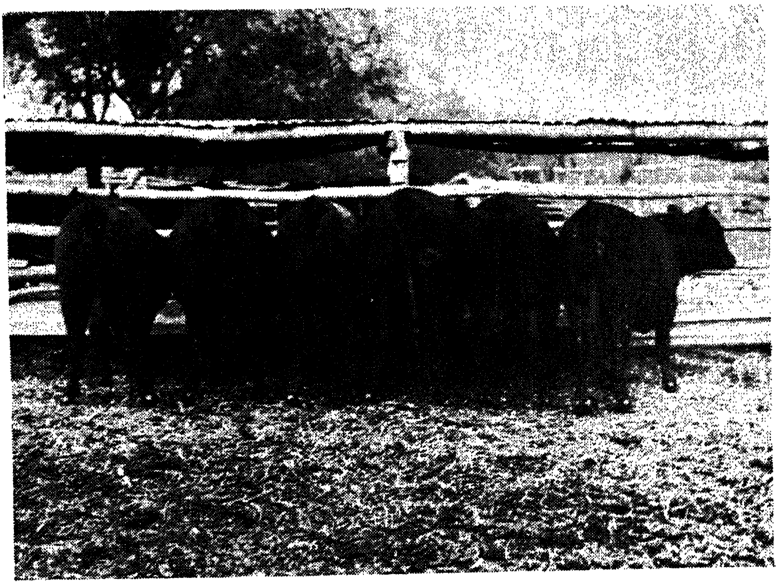
Group 3. Marketed at 2½ years.—Nine high Grade Aberdeen Angus and 10 Shorthorn steers in two separate lots were used for this group. Both groups of steers were purchased at the commencement of 1936 as weaners approximately one year old. Both lots were on veld grazing only from 18th February to 8th June, 1936, a period of approximately four months. From 9th June until 11th August, a period of two months, they were fed a small concentrate ration of 2-3 lbs. per head per day plus 2-3 lbs. of silage in addition to the grazing. From then on they were brought in and fed in pens, the concentrate ration being gradually increased to 6 lbs. per head per day. Supplementary feeding terminated at the end of November, *i.e.*, after three months.

From the 1st December, 1936, until early March, 1937, *i.e.*, for three months, the bullocks had veld grazing only. For one month they were then fed an average supplementary ration of 3.8 lbs. of concentrates per head per day in addition to the grazing. They were then brought into the pens and fattened for a period of five months, *i.e.*, from early April until early September.

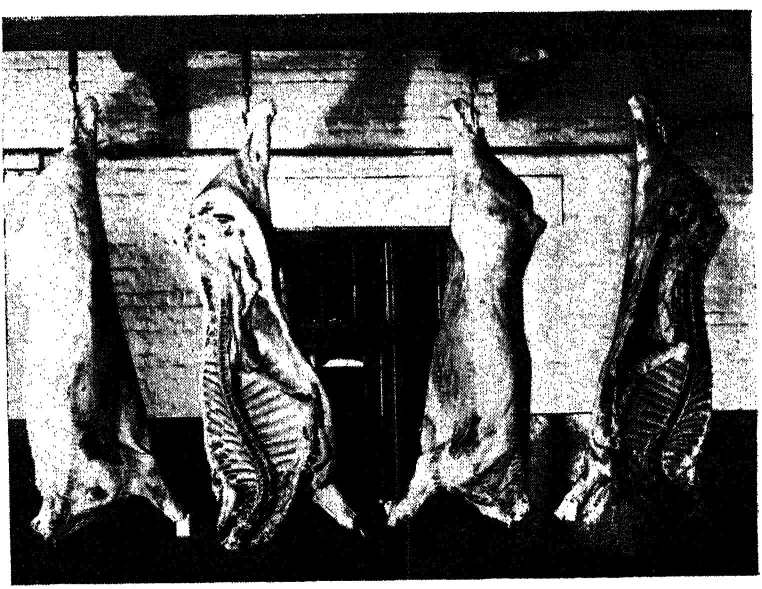
The concentrate ration throughout contained either peanut meal or peanut meal and meat meal as a protein supplement. The various supplements used are given in Table 2.

From the time that these calves were weaned until they were brought into the pens for fattening, the veld grazing, when unsupplemented, was sufficiently nutritious to maintain the desired rate of growth for only four months in 1936 and three months in the summer of 1937. At the end of these comparatively short periods it was necessary to supplement the grazing with other feeds to keep up the rate of growth required. It is possible that by improved veld management it will be practicable to considerably extend the productive grazing season at a cheaper cost than to use concentrates. This is one of the questions that is being investigated at the Pasture Stations at Marandellas.

2½ year old Bullocks.



18 months old Bullocks.



Carcases of above Bullocks.

The steers were marketed in September, 1937, and were then approximately 2½ years of age. The type of fattened steer is illustrated in figure 1.

Group 4. Marketed as Baby Beef—18 to 19 months of Age.—The twelve calves in this experiment were high grade Aberdeen Angus calves born in summer of 1936 and run with their dams until the following January, when they were weaned at an average age of eleven months. Calves of both sexes were used—seven steers and five heifers. The heifer carcases were at the end slightly superior to the steer carcases.

During the winter of 1936 the cows while suckling the calves were fed a maintenance ration of approximately 2 lbs. concentrate and 2 lbs. silage per head per day in a paddock while grazing. This feeding of the cows lasted for a period of approximately five months from June to November. During the latter four months of this period—July to November—the calves were creep fed a small supplementary ration of 1 lb. concentrates and 1 lb. silage per head per day so as to increase their rate of gain in liveweight. When weaned in January, 1937, they had veld grazing for a period of two months only. After this natural grazing was too low in feeding value to maintain the rate of gain in liveweight desired and the weaners were fed a supplementary daily ration of approximately 4 lbs. of concentrates per head per day while grazing for a period of one month, or until early in March, 1937. They were then penned up and fed until finished, a period of 170 days. They were ready for sale at the end of September, 1937.

The concentrate rations used throughout contained a protein supplement and the rate of feeding was regulated so as that the cattle would, it was hoped, reach market weights and finish at approximately 18-19 months of age.

The baby beeves were not quite as heavy or as young when marketed as was planned. The 1937 season was not, however, a particularly favourable one at the Matopo Estate and supplementary feeding was left just too late to produce the

full effect desired. The average weight at the time they were penned was 515 lbs., which is rather disappointing in view of the system of management.

In a similar experiment, for instance, now in progress at the Grassland Station, Marandellas, the average weight of 29 weaners at this stage was 700 lbs. live weight. The average gain of 1.87 lbs. per head per day made at the Matopo Station for the six months' fattening period is, however, considered good for this age of bullock.

The type of these steers is illustrated in figure 2.

In Tables 1 and 2 have been assembled the data showing the gain in weight and weight of meat produced in each lot together with (Table 1) the total amount of supplementary feed consumed per steer (Table 2).

It is not possible to give representative dressing percentages of the various lots as the cattle were weighed when despatched from this farm but not at the works previous to slaughter. The actual percentage figures obtained would therefore be considerably lower than if the bullocks had been weighed as is usual just before slaughter.

The dressed weights desired for chilled bullocks under our conditions are from 600-650 lbs. The three older lots of bullocks all fall within these limits. The baby beeves, though better finished than the other lots, were rather under weight for commercial purposes from the producer's and exporter's standpoint. Typical carcases of these baby beeves are shown in figure 3.

The point of most importance to be noted from Table 2 is the very much greater quantity of supplementary feed required per head to produce 1½ to 2½ year old bullocks of sufficient finish and weight as compared with those at 3½ and 5 years.

The actual quantities will vary with the methods of feeding, but under the conditions of this experiment it will

be seen from Table 3 that the cost in supplementary feed alone on the basis of the production cost used in these calculations, varies from 27s. 2d. per 100 lbs. of beef and £6 18s. 4d. per head in the case of 1½ year olds to 8s. per 100 lbs. of beef and £2 12s. 10d. per head for the five year old bullocks.

To justify the extra feed from an economic standpoint it would be necessary for the younger bullocks to sell at a very much higher price per 100 lbs. of beef than the older ones.

It is extremely difficult to get sale prices which are strictly comparable, as the market varies from day to day and from hour to hour.

From our past experience, however, we feel justified in assuming that, once the different grades come forward regularly in commercial quantities, the difference in price between them as compared with the five year old fattened bullocks would be baby beef an increase of 1d., 2½ years ¾d., 3-3½ years ½d. per lb. over the sale price ruling for five year old bullocks of the quality now produced in this Colony.

With these values in mind a glance at Table 3 will show that the cost of the extra food for the two youngest groups is out of proportion to the increase in price obtainable.

For an increase of 8s. 4d. or 6s. 3d. per 100 lbs. in the sale value of the beef between 1½ and 2½ and 5 years there has been an increase in the cost of feed of 19s. and 15s. 4d. per 100 lbs. respectively.

Against the increase in the cost of feed has to be set off the saving in time in the producing of the younger bullock, *i.e.*, 3½ or 2½ years, and the benefits of a quicker turnover of capital. We have insufficient data on the value of these savings, but a considerable number of the larger producers seem agreed that under conditions where cattle raising is the major enterprise on the farm or ranch, the total running costs, inclusive of depreciation on equipment and managerial wage, but exclusive of interest, should not exceed 7s. 6d. per beast per annum under present conditions. This figure would be somewhat higher for younger cattle on account of the more labour required in feeding and supervision. The interest costs are also likely to be higher for the younger cattle on

account of the higher value of the breeding stock and the more intensive improvements required to do justice to the young stock. The management costs which are saved are, therefore, not likely to outweigh the extra feed consumption.

As between the 3½ and 5 year olds there is, however, a good deal to choose. The extra selling price of the younger beef more than compensates for the extra feed and the year and a half saved is profit.

Under present conditions the most economic bullock for export to produce as a chiller is, therefore, the 3-3½ steer, provided it is well finished. This summary of the position is in keeping with the opinion frequently expressed by the practical cattleman and the meat trade that the most profitable bullock is the one that, within the age limit, is brought to the right weight and finish on the least supplementary feed. It must be emphasised, however, that the export trade in chilled beef is still in the development stage as far as we are concerned, and that more data are required in regard to costs of feeding in other parts of the country before this statement can be accepted as final.

There is also the reservation that the most pratical "quality standard" in the agricultural areas of Mashonaland is likely to be higher in other parts of the Colony where supplementary feed is more expensive to produce.

TABLE 1.

Gain in Liveweight and Weight of Beef Produced per Steer.

Group.	Average age when sold.	No. of lots.	Total No. of heads.	No. days in fattening period.	Average weight commencement of fattening period. lbs.	Average final weight on farm. lbs.	Average gain weight, lbs.	Average daily gain, lbs.	Weight of beef.*
1	5 years	10	148	89	987	1,200	213	2.39	646
2	3½ years	4	39	58	1,080	1,175	95	1.63	627
3	2½ years	2	19	157	700	1,103	403	2.57	610
4	1½ years	1	12	179	515	849	334	1.87	508

*Cold dressed weight.

TABLE 2.

Total Feed consumed per Steer.

Group.	Nyouti or maize meal.	Sunflower head & Sunflower meal.	Peanut meal.	Meat meal (Liebig's).	Blood meal.	Concentrates.	Veld hay.	Cowpea hay.	Silage.
1. Feed consumed	976		61		27	1,064	970	86	484
2. Wintering suppls.	173		289			462		406	278
Fattening .	519		23		18	560	910	112	1,317
Total	692		312		18	1,022	910	518	1,595
3. Wintering suppl.	396	135	154			685			476
Fattening .	1,673		250	58	67	2,048	879	741	2,088
Total	2,069	135	404	58	67	2,733	879	741	2,564
4. *Wintering suppls.	361	125	144			630			464
Fattening .	1,707		256	59	68	2,090	833	537	2,090
Total	2,068	125	400	59	68	2,720	833	537	2,554

*Including feed to cows and calves in creep while suckling.

TABLE 3.

Cost of Supplementary Feed Consumed.

Group.	Age when marketed.	Cost per Steer.	Cost per 100 lbs. of beef produced.
1	5 years	£2 12 10	£0 8 2
2	$3\frac{1}{2}$ years	3 2 11	0 10 0
3	$2\frac{1}{2}$ years	7 2 2	1 3 3
4	$1\frac{1}{2}$ years	6 18 4	1 7 2

Feed costs at time of these experiments taken at:—

Concentrates average $\frac{1}{2}$d. per lb. (8s. 4d. per 200 lbs.)

Cowpea hay at 30s per ton.

Veld hay at 10s. per ton.

Maize silage at 10s. per ton.

How to Instal a Simple and Efficient Hot Water Supply on a Farm.

By W. A. Welch, Tantallon Farm, Salisbury.

To have a constant supply of hot water, whether in the bathroom, scullery and laundry, or outside, for dairy and other purposes, is an amenity on a farm that many would like to possess, and it is with a view to showing how it may be brought about that the following article is written. No attempt is made to meet the requirements of town dwellers, for whom qualified workmen are available for fitting up a hot water supply, although the principles involved in the following instructions, which can be carried out by the average "handyman," are exactly the same as for a town "villa" or a many storied hotel.

The writer has in mind that the petrol or oil drums so readily obtainable in South Africa will form the principal item of the installation. If one man has an old vertical steam boiler that is still watertight and another prefers to use a small boiler fitted at the back of the kitchen stove, the substituting of these for the steel drum boiler as herein described will make no difference other than that of larger or smaller heating surface; the pipe constructions will remain the same. There are two fundamental principles in hot water engineering that have to be borne in mind: (1) Water will always rise to its own level and (2) hot water is lighter than cold; the efficient working of a hot water installation is based on these two laws. The illustration Fig. 1 shows a tank A. and a vent pipe G. Now no matter how intricate the connections may be through piping and other drums, the water in pipe G. will always stand at the same level as in the tank A. The second principle works as follows:—Let us suppose an installation as shown in Fig. 1 is filled with cold water and a fire is lighted under B.; as the water in B. becomes heated it rises and passes through the pipe E. into

the cylinder C., an equal amount of water replacing it by passing from C. down the pipe F. into the bottom of the boiler. This motion of the water (and it does actually move; it is not merely heat radiating through the water) is called the "flow" and "return," and will continue as long as there is a fire to heat the water in the boiler. If the fire is allowed to go out, the hot water contained in B. and C. is still available for use, and when drawn off through the pipe H. cold water flows through pipe D. into the boiler, but not so as to affect the temperature of the water in C. until all the hot water is used up.

Water Supply.—Now having tried to show the way the thing works, let us come to the actual installation, and for this we must start with the water supply. Some farmers are much better off in this respect than others, but for our purpose we may put them into three classes: (1) Those who have a supply brought to the house in a pipe line from a reservoir at some elevation above the house. These will need to fix a ball tap to the cistern A. (2) Those who have a reservoir or windmill tank at about the level of the roof of the homestead. These need not fit the cistern A., but may connect their supply of cold water direct to the bottom of the boiler. If the source is at some distance, the piping should be not less than 1 inch and fitted with a stop cock and, most important, it must be ascertained if there is any means of support for the vent pipe G., the top of which must be a foot or more above the highest level of water in the reservoir or tank. (3) Those who have to fill the cistern A. by hand or pump. These should endeavour to have as large a cistern as circumstances permit or the demand for hot water necessitates.

Cold Water Cistern.—The distance of this from the boiler is immaterial and the most convenient spot may be selected for it. Its *height* requires consideration. The higher it is placed the faster will be the flow of water at the bath and other taps; on the other hand, it should not be placed so high as to create a difficulty in fixing the vent pipe G., the top of which must be a little higher than the surface of the water in the cistern when filled. It would not be advisable to poise a length of piping, say, 10 or 12 feet, on the top of C. without some lateral support (see under "Piping"). It is well to have a cover to the cistern to exclude mosquitoes, but it must not

be airtight. The cistern requires one threaded socket at the bottom into which the pipe D. is screwed. This pipe may be connected directly to the bottom of the boiler or to pipe F. In either case it should be dropped slightly so that it enters the boiler or pipe F. from below. This will prevent any heat from creeping back to the cistern (see the T connection

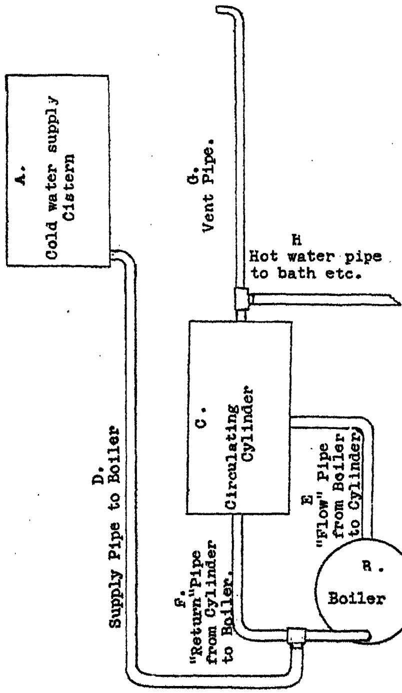


Fig. 1.

between D. and F. Fig. 1). Those who have a water supply at pressure (class 1) may fix their ball tap through a hole punched near the top of the cistern holding it in position by means of a back nut and fibre washer. They should also fix a short length of piping in the same manner to serve as an overflow.

Boiler.—There are two types of drum commonly obtainable. One, either barrel shaped or straight sided, has two screwed plugs fixed in one end (Fig. 2), the other type is straight sided with the small plug at the end and the large one in the centre of the side (Fig. 3). Usually these plugs

are $\frac{3}{4}$ inch and $1\frac{1}{2}$ inch. To make use of these without alteration they must be fixed as shown in Figs. 2 and 3 respectively.

In Fig. 2 the flow pipe E. is screwed into the small socket and the return pipe F. and the cold supply pipe D. are connected to the large socket and an extension piece fitted inside the drum as shown by the dotted lines, reaching to within about 2 inches of the bottom. The manner of making the connection of this extension piece is given under "Piping and Connections."

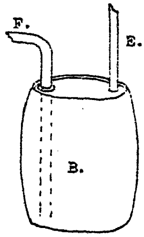


Fig. 2.

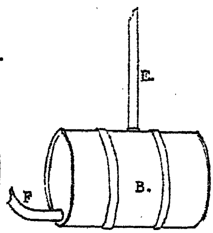


Fig. 3.

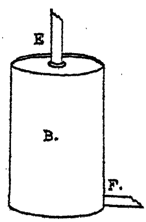


Fig. 4.

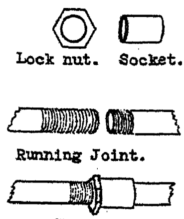


Fig. 5.

The other type of drum must be built in horizontally, the "flow" and "return" pipes being connected as shown in Fig. 3. A third type for the boiler is shown in Fig. 4. This would probably require to have one connection specially brazed or welded into the position shown. A drum of the type in Fig. 3 can be adapted as follows:—First, permanently close the large plug at the side; stand the drum on end with the small plug at the top and have another socket welded into the position shown in Fig. 4. The advantages of using the drum vertically as a boiler are referred to under the heading "Building."

Circulating Cylinder.—For this a drum of the type in Fig. 3 is best, the two existing sockets serving for making the connections of pipes E. and G. (Fig. 1). Another socket must be welded in for the connection of pipe F. In erecting this cylinder the height is determined by the boiler B. and the cistern A. It must be sufficiently higher than the boiler to allow of pipe E. being easily connected, but as much below A. as is practicable. In any case the T connection between G. and H. must be lower than the bottom of cistern A., the lower the better. The closer the cylinder is kept to the boiler the better. If the latter is being totally enclosed in brickwork the cylinder may be enclosed in the same structure, or if the kitchen or scullery be handy it may be fixed indoors. It is advisable not to have it exposed to cold wind or frost.

Piping and Connections.—As a general rule $\frac{3}{4}$ inch piping will suffice, this being the size that fits the small sockets in the drums. The large sockets have to be fitted with "bushes," obtainable from piping suppliers, so as to reduce them to the $\frac{3}{4}$ inch. The piping G. from the T upwards need only be $\frac{1}{2}$ inch. If a little extra expense in having larger sockets fitted to the drum is no obstable then pipes D., E. and F. can with advantage be 1 inch. The outlet at the top of C., the T socket and the hot water draw off pipe H. need not be larger than $\frac{3}{4}$ inch. Presuming that the bathroom and other taps are on the ground floor then the T socket should be close to the top of C. If the installation is in a storied building and the hot water is required on an upper floor then the cistern A. and the vent pipe G. must be carried correspondingly higher and the T connection taken off at a convenient point.

In running the pipe line H. to the bath or other points for drawing off keep it on a descending line as far as possible and only rise again to a point where there is a tap. Use a spirit level for this if necessary. The reason for this is that air may enter this pipe and it should be higher at both ends than the central portion so that air may escape either to the vent pipe G. or by one of the taps. Do not have a high spot where air may be trapped.

The length of pipe G. is to be carried slightly higher—say, 12 to 24 inches—than the level of the water in A. when full, and it is advisable to fit a bend at the top pointing in a direction that will avoid any person being scalded, as, should

the fire under the boiler be too fierce, steam and boiling water will gush out of this vent pipe. It should, if possible, be kept vertical, but if necessary to run it obliquely at a gable end in order to reach a chimney for support, keep it rising as sharply as possible. As it is not possible to make every joint between A. and B. and B. and C. with the ordinary screwed and socketed joint, one of the joints has to be fitted specially. There are fittings made for this purpose called "union sockets," but the expense of these can be avoided by making a joint, as shown in Fig. 5, at some convenient point between the two drums to be connected. In addition to the ordinary socket a back nut is required. To make this connection work back from both drums so as to have two lengths of piping meeting true and close. On one length the thread is cut the usual length, on the other it is cut long enough to take the back nut and the full length of the socket. Screw the back nut on first, then the socket until it is back flush with the end of the pipe. Bring the ends of the two pipes together and screw the socket forward until it is tight home on the short thread. The back nut must now be screwed tight up to the socket, some packing tow smeared with the jointing compound being first wound round the pipe between the back nut and socket. One of these called "running joints" is necessary in pipes D., E. and F., and it is advisable to make use of one or more of these indoors. It simplifies fixing and taking down for alteration, etc. Where possible use "bends" in preference to "elbows" when making rectangular joints, particularly in pipes E. and F. To fit the length of piping inside the drum —Fig. 2—measure the depth of the drum inside and cut off a length of piping about 1 inch shorter. Cut thread at one end long enough to screw through the reducing bush and to project half the length of a socket. Screw the piping into the bush, fix the socket on the projecting end then screw the whole into the drum.

Tools, Etc.—The following tools are necessary, excepting in cases where the piping is being cut and screwed to measurement by pipe merchants:—Hack saw, coarse file, pipe stock and die, two pipe wrenches, vice. If a pipe vice is not available a leg vice or bench vice will do; an assistant with a pipe wrench to grip the pipe that is being screwed can supplement the grip of the vice.

To those inexperienced in cutting thread on piping the following advice is offered. If the end of the pipe has not been cut off square, have it square and slightly round off the outer edge with a file. Do not attempt to cut the thread the full depth at one cut. Pipe dies are adjustable and a light cut should be made first, and by going over the length of thread that is being cut four or five times, adjusting the dies to cut a little deeper each time a cleaner thread is cut and it is better for the dies. Keep a little oil on the thread whilst cutting. It is well to use a jointing compound to ensure a water tight joint, failing anything better ordinary oil paint will do; red lead is better, or there is a steam jointing compound sold that is good, as it allows of joints being unscrewed more easily when alterations, etc., may be necessary.

Building in the Boiler.—The type of drum for the boiler that will appeal to most as being simple to fix is the horizontal type (Fig. 3). Where economy of fuel and the absence of

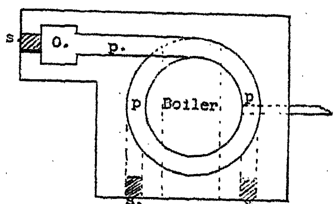


Fig. 6.

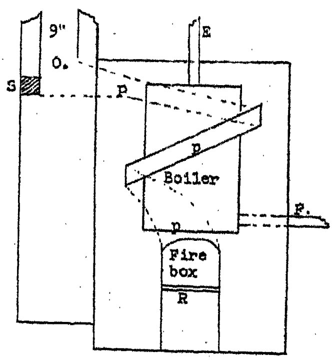


Fig. 7.

O. Chimney. P. Flue. R. Fire bars

smoke and ashes are of little account it may be just built on a brick pedestal with a fire box underneath and a dwarf chimney at the back. This may be improved upon by raising

the chimney and also by arching the top over with brickwork either with or without a cavity extending from the fire over the top of the boiler and back to the chimney. In whatever way it is set do not have any of the pipes or connections exposed to the fire or you will soon have leaking joints. A much better job is to fix the boiler vertically as shown on sketch and plan Figs. 6 and 7. This requires a chimney, preferably at the side and built independently so that in the event of the boiler requiring to be re-set at any time the fabric of the chimney is untouched. Fig. 6 shows the boiler over the fire box, which is provided with fire-bars for about two-thirds in from the front and extends inwards about 9 inches beyond the boiler; a flue 4 inches wide by 6½ inches (two bricks) high is carried from the back of the fire once round the boiler and rising gradually so that it enters the chimney at about the level of the top of the boiler. This will be found to have a greater heating efficiency with a lesser amount of fuel than a straight through fire under a horizontal boiler. The chimney should be 9 inches square inside and, in building, holes should be left at the three places marked S. to allow of the flue and bottom of the chimney being cleared of soot or ashes. These "soot doors" should be the size of half a brick, and when the building is completed they should be closed by inserting a half brick just "pointed" with mortar—a piece of hoop iron hooked at both ends being inserted under the brick to facilitate withdrawal.

Witchweed and the Labour Shortage.

By S. D. Timson, M.C., Assistant Agriculturist.

Farmers in most parts of the maize belt report a serious shortage of labour, which will naturally react adversely on the campaign against witchweed, since hand cultivation is still the most widely used weapon against this parasite.

It is thought that in some cases where the shortage of labour is at its worst that the method of destruction of witchweed by spraying with a dilute solution of sodium chlorate may come into its own in these special circumstances and relieve the labour shortage.

In an article published in the January, 1933, issue of this journal the writer gave the results of and conclusions drawn from a large-scale trial of this method of control carried out in co-operation with Mr. A. G. McCall on his farm at Glendale, and the reader is referred to this for details of the practice. Briefly, the results of this and other trials were as follows:—

(1) A 1½ per cent. (1½ lbs. in 10 gallons of water) solution of sodium chlorate when properly applied in the form of a fine spray gave 100 per cent. kill, *and none of the parasites killed grew up again from the same "roots" or stems.*

(2) Spraying by the simple system outlined was more than twice as rapid as light surface hoeing. By the former method the rate of work was 1.08 boy-days per acre, and by the latter method 2.36 boy-days per acre.

(3) Spraying was found to be cheaper than hand cultivation.

(4) Spraying with sodium chlorate when the infestation is severe would cause an undetermined loss in the yield of maize owing to the poisoning of the maize plant by contact

of the spray blown on to the leaves, and by the passing of the poison through the junctions between parasites and maize plants into the latter.

(5) It was found that three boys working one pneumatic pump were able to spray a light general infestation at the rate $7\frac{1}{3}$ acres per 10 hours working day.

Owing to the capital cost of the spraying apparatus the writer has not advised the use of this method in the past, except in exceptional circumstances, but if a farmer finds himself faced with such a shortage of labour that he cannot control the parasite by hand cultivation he is strongly advised to give spraying a trial, and face the considerable capital cost of the necessary outfit rather than allow the parasites to seed down and destroy years of work. The only type of apparatus recommended is the pneumatic type knapsack sprayer(of at least 3 gallons capacity) with a hand-trigger control. The trigger control is considered essential in order to avoid wastage of the sodium chlorate.

Farmers are advised to review their labour position carefully, and if they decide that there is likely to be a serious shortage, they should place their orders for the spraying outfits at once, since it will probably be found necessary to obtain them from outside the Colony.

Supplies of sodium chlorate should also be ordered at once, and the amount of the latter required per acre of a fairly severe general infestation would be between 3 to 6 lbs. per acre. per acre.

A pneumatic type of sprayer has been specified above as necessary, but if the ordinary knapsack sprayer can be obtained with a trigger control instead of a turn tap, or if it can be fitted with trigger control, it would be quite satisfactory.

Fire Hazard.—It is desirable once again to warn those using sodium chlorate as a spray that articles of clothing, including boots and shoes, sacking and similar organic materials, which become soaked in the solution, on drying out are very inflammable, and should be thoroughly washed after use, to avoid the danger of fire.

Use of Single Draught Animals.—Another method of economising hand labour has been repeatedly advised by this Department in the past, but seldom, as far as the writer is aware, adopted in this Colony, and that is the use of single draught animals (oxen, donkeys or mules) for pulling a light cultivator with cutting points (such as the horizontal duck-foot type), for continuing with the cultivation of witchweed between the rows, after the maize is too high for normal methods of cultivation.

Nearly every farmer has a few quiet old oxen suitable for this work and can make single-ox yokes from farm materials as first described in the March, 1930, issue of this journal. The purchase of a few donkeys will be vastly cheaper than the results of leaving witchweed to seed down in the land.

The following is the description of the single-ox yoke taken from the note mentioned above written by C. A. Kelsey Harvey, and the accompanying illustrations make the matter clear.

"There are reproduced herewith three photographs of a single ox yoke made from native timber which has been doing effective work on the Tobacco Experiment Station this season. This yoke was devised principally to cultivate closely spaced crops such as beans, ground nuts and sunnhemp grown for seed. The ordinary type of double cultivator yoke is generally too cumbersome when crops are spaced less than 3 feet apart. It was also found useful for cultivating up and down the lines of tree plantations on the station, and should be valuable for the late cultivation of 'witchweed' infested maize crops.

"The yoke is cut from a forked branch of M'sasa or M'hasha wood and shaped with an adze to fit the animal's neck. Two ring bolts are inserted 8 inches to 10 inches from the top of the yoke, to which are attached the traces made of ordinary reims. The two ends of the fork are shaped like skeys and are notched to take the strop. The yoke when completed is 2 feet 6 inches in length, and weighs 12 lbs. when the wood has dried out."

Captain Moubray, of Chipoli, Shamva, has for some years past employed single donkeys pulling a light cultivator for his inter-row cultivation.

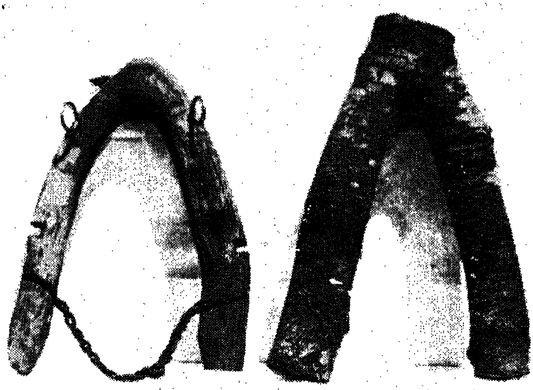


FIG. 1.

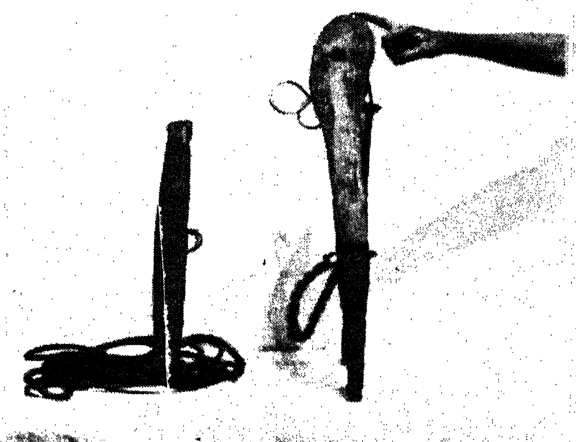


FIG. 2.

Mr. A. W. Laurie, of Howick Vale, Concession, last year successfully employed two donkeys driven in tandem for the same purpose, harnessed to an ordinary expanding 7-tine cultivator. The harness was made from old discarded power belting and rope, and the only material he had to purchase was a box of copper rivets.

Wide Spacing of Maize.—Another system of planting and cultivation which is of great value in economising hand labour is by planting maize at a spacing of 6 feet between the rows and 9 inches between the plants in the row.

Such a spacing allows of a section of a spring tooth harrow being used for killing the witchweed between the rows, thus greatly reducing the amount of witchweed requiring hand-hoeing to the comparatively small quantity growing in the rows of maize plants. The harrow is driven up one side of the 9 foot interspace as close to the maize as possible, and then down the other side. Mr. G. P. Ingram, of Concession, has used this system of cultivation with success; but during the past season he changed over to the use of an ordinary adjustable 7-tine cultivator fitted with a half "sweep" attached to the hindmost inside (left hand) point instead of the ordinary tine. The outer edge of this half sweep is easily worked closely up against the row of maize, and he finds this preferable to the use of the section of spring tooth harrow owing to its being more easily controllable.

With this spacing (6 feet by 9 inches) the same number of plants occupy an acre as with the normal spacing 36 x 18 inches, and three series of experiments carried out on the Agricultural Experiment Station at Salisbury have shown that such a spacing gives the same yields of maize as the normal spacing of 36 x 18 inches. These trials extended over four seasons of varying rainfall.

A Cheap Portable Colony House for Poultry.

By G. H. Cooper, Assistant Poultry Officer.

The Colony House described here was first made and tested out at the Matopo School of Agriculture, proving very serviceable, practical and cheap. It is now in general use on many farms. It is primarily intended for young stock, either pullets or cockerels on free range, but may also be used in a wire-netting enclosure. With the addition of perches it may be used for a few mature stock such as a breeding pen for old breeding males on range.

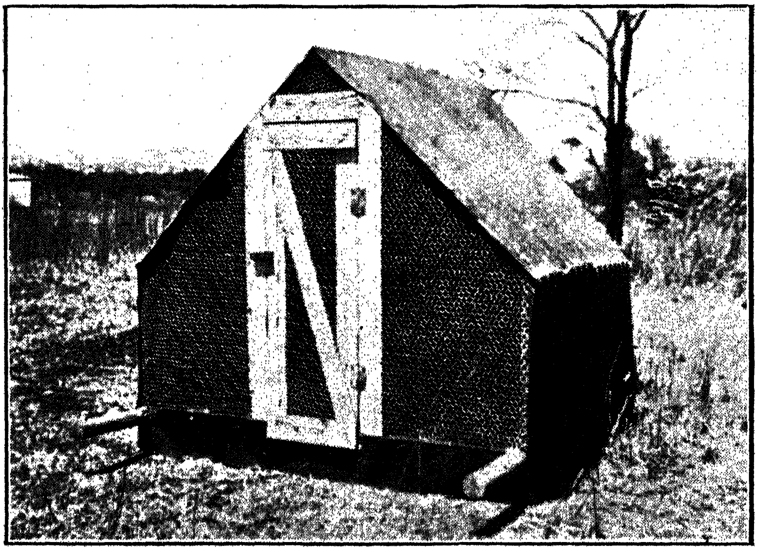
Construction.—Take two sheets of corrugated galvanised iron 10 feet x 2 feet. Bend each sheet at right angles in the middle at the 5 foot mark. To do this tap the centre line lightly with a cold chisel and hammer to dent it, but not cut through. Place one end upon a box, step on the other end and advance towards the centre line; the iron will bend in a straight line where dented and may then be pulled into a right angled bend with the hands.

Again 1 foot 6 inches from each end bend each sheet as described previously to an angle of approximately 135 degrees.

Place the two sheets together, allowing one corrugation of one sheet to overlap one corrugation of the other sheet in a similar fashion as when using iron for roofing. Fasten the two sheets together with a few gutter bolts where the one overlaps the other to form one unit.

With the ends of the sheets on the ground the structure now has the appearance of a small building with two upright sides and a pointed roof. It is 5 feet wide across the open ends at the bottom, 4 feet deep, being the width of the two sheets of iron, and 4 feet high at the apex.

Next construct a rectangular framework 5 feet x 4 feet of 2 inch x 2 inch timber, or straight 2 inch diameter gum



poles, if available. The two pieces of timber used for the 4 feet sides should be cut 6 feet in length and allowed to project beyond the framework 1 foot at each end. Along the 4 feet sides two pieces of No. 10 plain galvanised wire are looped across the framework, 16 inches apart, and each twisted to tension. Similarly across the 5 feet sides three wires are twisted to tension 15 inches apart. Where these wires cross in six places they are held together by means of baling wire. These cross wires keep the framework securely together and serve as supports for the floor of wire netting and the weight of the birds. If available, hoop iron stretched and laced across the timbers at right angles is better than wire, for it supports the netting floor over a greater area. If the timber used has a tendency to bend inwards it will be necessary to include two pieces of similar timber in the form of a cross in the middle of the framework, in which case the centre wire between the two 5 feet sides can be dispensed with. Over this rectangular framework attach ½ inch mesh wire netting stretched tight to form the floor of the house.

Place the floor thus constructed into the corrugated iron structure with the four 1 foot timber projections at each corner to the open front and back of the house. The 5 feet sides of the floor will be in a line with the edges of the iron structure both front and back. Raise the floor 6 inches from the ground level and fasten into position by means of screws with washers through the corrugated iron sides. The 1 foot timber projections at each corner serve as handles for transporting the house.

Along each edge of the corrugated iron sides both front and back from floor level to the apex attach pieces of 1 inch x 1 inch timber by means of screws through the iron.

Cut ½ inch mesh wire netting to fit the open front and back and attach one piece to one end by means of staples in the floor framework and the light timber around the edge of the iron. This end, which will be the back of the house, may now be thatched over the wire netting to within 9 inches of the apex; or, if desired, the netting may be dispensed with and flat or corrugated iron attached instead, leaving a small triangular opening at the apex 9 inches deep for ventilation purposes. This triangular opening must be covered with

½ inch mesh wire netting to prevent chickens getting out or vermin getting in. The flat iron back makes a stronger and more permanent structure.

On the front two pieces of light plank such as 3 inch ceiling board are nailed to the floor framework and the timber on the sloping sides near the top, 2 feet apart, to form a doorway in the centre. The open spaces on either side and above the doorway are covered with ½ inch wire mesh netting.

A light door is made to fit the gateway, covered with the netting and fastened in position with hinges and fastener. Butt hinges similar to those purchased can easily be made from odd pieces of flat galvanised iron and a wire nail.

In the door itself another sliding trap door may be made, if desired, large enough only for birds to go in and out. This is useful when mature birds are kept in these houses, for the nest boxes can be put inside during the day time. If the door is fitted with a padlock the eggs are kept safe until collected.

The open spaces 6 inches deep in the front and back between the floor and ground level are closed by nailing strips of flat galvanised iron to the floor framework. This is necessary to prevent vermin from getting at the legs and feet of the birds from underneath the netting floor.

Uses.—The Colony House is now complete and will hold 20 mature light breed pullets or 50 at two months of age. It is all that is required in the way of housing during the time of year when pullets are growing. Pullets should be introduced to these houses at about two months of age and may remain in them until they begin to redden up, when they are shifted to permanent laying quarters.

If mature birds are kept in this type of house, three perches of 2 inch diameter timber should be placed across the house 4 inches above the floor and fastened in position by means of screws through the iron sides into the ends of the perches, or by means of some arrangement whereby the perches can easily be removed if necessary.

All droppings from the birds pass through the netting floor and so cleaning is only necessary occasionally. The birds cannot get at the droppings and they may be collected. These

houses are portable and best used on free range, when they should be shifted around occasionally and placed about 30 yards apart for the best results.

Experience has shown it is advisable to shift these houses and clean up the droppings at least every week or two, otherwise fleas are likely to become a pest. After moving to a new site a few yards away it is always a good plan to place some grass on the old site and burn it to kill off any fleas or their larvae.

No timber is in contact with the ground, so the house is proof against termites.

A larger house of the same type may be made by using three sheets of 12 ft. corrugated iron. This size has a floor space of 6 ft. x 6 ft. and, of course, longer timber has to be used in construction of the floor. It is a very useful portable house indeed for nearly mature pullets or cockerels.

This type of house may also be made very cheaply in various sizes from old tar drums. The top and bottom are cut out, the drum is cut lengthwise and flattened out. Any number may be rivetted together to give the desired size of house. The tar acts as an excellent preservative and insect deterrent.

Use the outdoor feeder described in a previous article with this type of house, both of which may be constructed easily and very cheaply on the farm.

Cement Paint.—If it is desired to use old iron in the construction of these houses, it will be very beneficial to give the iron two coats of cement paint when constructed. This will effectively block up small holes and preserve the iron for many years if in fair condition. It is made as follows:—Equal parts of raw linseed oil, paraffin, cement and red oxide are taken, well mixed and allowed to stand for 12 hours. Stir thoroughly and pour through a wire sieve. Apply with a brush, stirring occasionally. Six cups of each ingredient will make one gallon of this paint.

The Raising and Planting of Trees on the Farm.

By E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.

The following article is intended to meet the requirements of the farmer and general tree planter who find it more suitable, for reasons of economy in transport and expense, to raise their own seedlings and transplants than to purchase stock raised by nurserymen. It is a combination of extracts from Bulletins Nos. 817 and 874 which dealt with the raising of seedlings and transplants and with the planting out of trees respectively. The procedure advocated refers mainly to the commoner trees planted in this Colony, *viz.*, eucalypts, pines, cypresses, callitris, cedrela and jacaranda.

It may not be out of place to explain some of the terms used. A seedling is a young tree resulting from the sowing of seed and it may be any height. A transplant is a seedling that has been removed by transplanting from its original site in the seed-bed to tins, trays or nursery beds for a further period of development before final planting out.

RAISING PLANTS.

Source of Seed.—Seed may be purchased from Government Forest Nurseries as quoted in Departmental price lists, or from nurserymen of standing. If, however, trees of the species it is desired to establish are thriving in the locality, it may be cheaper to collect seed from them. Only well formed mother trees should be selected, and, *ceteris paribus*, trees bearing excessively heavy crops of seed should be avoided, as their condition may indicate ill-health or non-suitability to the locality.

Branchlets carrying ripe seed vessels or cones should be picked and piled on a sheet of canvas or some large open vessel, and placed in the sun in a spot protected from wind.

In the course of two days to a fortnight the vessels will open and free the seed. Shaking and turning over the pile will accelerate liberation. The seed is finally collected from the threshing floor, and, if not to be sown immediately, should be stored in a cool, dry place. It is obvious that single seeded fruits will not need this treatment.

Quantity of Seed for Planting Requirements.—It is wise to sow sufficient seed to produce more plants than the ultimate number per acre required for planting. To ascertain the approximate number of plants required per acre for any planting distance, in the more usual square-planting, the rule is to divide the number 43,560 by the square of the planting distance, thus:—

$$\text{Planting distance} = 6 \text{ feet by } 6 \text{ feet}$$
$$\text{Number of plants required} = \frac{43{,}560}{6 \times 6} = \frac{43{,}560}{36}$$
$$= 1{,}210 \text{ plants}$$

In order to produce at least 1,210 plants, the following quantity of seed should be sown:—

Eucalyptus saligna, E. botryoides, E. rostrata, E. tereticornis, E. punctata, E. maideni, E. microcorys,	1 oz.
Pinus radiata, Cupressus torulosa, Cupressus lusitanica, Cupressus arizonica, Callitris calcarata, C. robusta, Cedrela toona	3 ozs.
Pinus longifolia	4-5 ozs.

Time of Sowing.—Eucalypt seed may be sown during August to mid-November for planting out during the same rainy season.

Cedrela toona should be sown fresh immediately after ripening in December for planting out during the same rainy season.

Seed of pines, cypresses and callitris may be sown during February, March and April for planting out in the following rainy season.

Preparation of Seed-beds.—The nursery should be in a locality near permanent water, protected from winds and carrying a well drained soil. Due regard should be paid to the distance of the planting area and, to facilitate supervision, the homestead.

The soil should be well broken up and reduced to a fine tilth. No sticks, stones or clods should be left in the upper 3 inches of soil. Sterilising by burning and fertilising are not ordinarily necessary. A light sandy loam is suitable for a temporary nursery. For a permanent nursery a mixture of heavier soil and leaf mould may be added to the end that the soil will be both friable and retentive of moisture.

When the soil has been well tilled, beds 3 ft. 6 ins. in width, of any suitable length, and about 20 ins. apart, should be marked off, levelled and pressed down to ensure a smooth surface. Plate 1 shows a suitable implement to smooth the surface of the beds. It consists of a board nailed to a handle.

As an alternative to the use of seed-beds, half petrol tins, filled with soil as already indicated, may be utilised. They have the advantage of being easily transportable to the pricking-out site, and, when uneven germination is experienced, they enable the grower to work systematically with the seedlings as they reach the pricking-out stage. Direct planting is not ordinarily advisable from seed tins.

Sowing the Seed.—Seed may be sown broadcast, the density of sowing being dependent on the desired subsequent treatment. If it is intended to prick out seedlings into tins or trays, 3 to 4 ozs. of eucalypt seed and 6 to 8 ozs. of conifer seed may be sown to the square yard. The easiest way to gauge the density of sowing is to aim at a condition where slightly more seed is visible on the seed-bed than soil.

If the seedlings are to be planted out direct from the seed-beds a much lighter sowing—about 1 oz. to every 10 to 20 sq. yds.—should be carried out, dependent on the size of the seed.

For planting out direct, line sowing may also be adopted. Seed is sprinkled along the surface of the bed, or dibbled-in, in the case of large seeds, in lines about 6 ins. apart. This

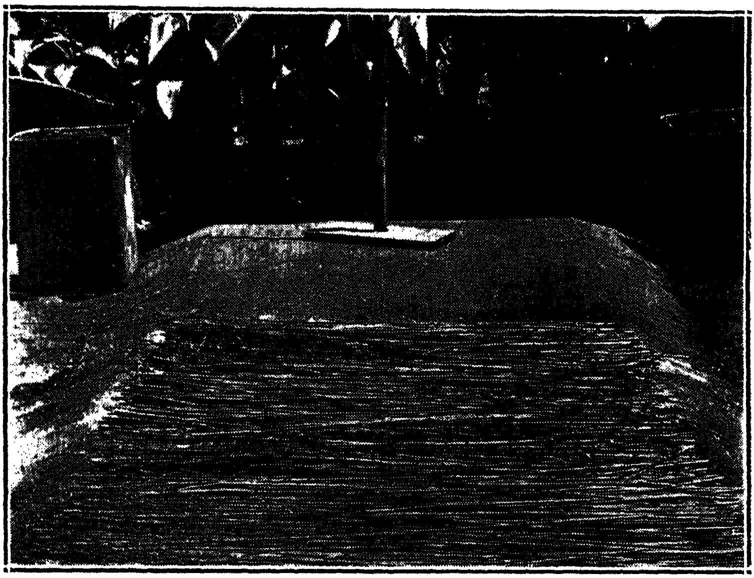


Plate No. 1 —Method of making seed-beds. Note the board for levelling and grass cover. Well combed grass should be used.

Plate No. 2.—Method of raising trees in lines in the beds (cutting the tap roots).

system naturally requires more space than broadcast sowing, but it has the advantage that thinning, weeding and root pruning operations are facilitated.

Broadcast sowing by hand gives good results in most instances. With very fine seed it may be sometimes advisable to mix the seed with fine sand to ensure even distribution. The sowing of eucalypt seed through a watering can is neither necessary nor advisable. When the seed has been sown it should be covered with a layer—the depth equal to the breadth of the seed—of sand or other soil which has previously been put through a sieve of fine mesh. The beds, or seed tins, should now be covered with well combed grass of sufficient thickness so that the soil cannot be seen. See Plate 2. As the grass may come in direct contact with the seed it is important to have it well cleaned, otherwise "white ants" may be attracted to the beds. A good watering should now be given to the seeds through the grass. Hessian may be used instead of grass, but, especially with eucalypts, it renders the operation of gradually lessening the shade more difficult.

Care of Seed-beds.—Watering of the beds should be carried out once or twice daily. The weather conditions prevalent over the germination period will indicate the frequency of watering desirable. Success lies in keeping the soil moist, though not sodden. Germination should take place within six to fourteen days in the case of eucalypts and cedrela and fourteen to thirty days or more for pines, cypresses and other conifers.

When germination is complete most of the grass should be removed, a very light covering being left for a few days to enable the young seedlings to harden off. All the grass should then be removed. If the grass is left on too long the seedlings will tend to spindle and will be useless for pricking out. This operation of removing the shade gradually is very important, especially with eucalypts, which are extremely tender in early youth.

In the case of beds sown for plants to be planted out direct in the field, the seedlings should be thinned out where they are to dense, leaving about 80 seedlings to the square foot. Thinning should be done by cutting out undesirable plants. Pulling is bad practice, as it damages the roots of the plants

which are to remain. Weeding should be carried out whenever necessary, and waterings must also be frequent.

With eucalypts, when the young plants have from six to ten leaves, root pruning should be resorted to at intervals of about three weeks to encourage the formation of a fibrous root system. The operation is carried out by inserting a long-bladed knife or sharp spade 4 to 5 inches below the surface. With other species root pruning should start when the plants are $1\frac{1}{2}$ to 2 inches high. Line sowings are more easily treated by this operation. See Plate 3.

Inoculating Soils for Pine Seedlings.—It is necessary at this stage to draw attention to a soil requirement which appears to be essential to healthy pine growth in various parts of the Colony. This requirement is a fungus which, apparently acting in association with the roots of pines, enables them to carry out their normal function. Without this fungus assistance the young pines tend to remain stunted and to bear an unthrifty, sickly yellow appearance. It would appear that the soils carrying thriving pine plantations are well infected with the fungus. When soil from such plantations is introduced to new nurseries, healthy pine seedlings result. This procedure is now advocated wherever pines are to be raised. It is well to inoculate the soil both in the seed and transplant beds or tins. A handful to the square foot would suffice, and should be forked or raked into the new soil.

Pricking Out.—The primary object of all pricking out is to ensure that each plant shall have a well-developed root system. Where seedlings are pricked out into tins or trays, the resulting transplants are finally planted out with a ball of earth surrounding each root system. In inexperienced hands and in a climate where droughts are frequent, balled plants are liable to less risks in planting out and are more capable of readily establishing themselves than open-rooted plants, which are used when seedlings have been pricked out into beds. The latter method is obviously cheaper, although it is in turn more expensive than the use of plants set out direct from seed-beds.

Pricking Out into Tins or Trays.—Petrol tins cut longitudinally in half or wooden boxes approximating them in size are most commonly used for the reception of pricked out

plants. A few holes to facilitate drainage are punched in the bottom of the tins, which are then filled almost to the top with, preferably, previously prepared soil. Such prepared soil might consist of three parts heavy loam, three parts sand and one part well rotted vegetable matter. This should be well mixed, sieved if necessary, watered and thrown into a heap until required. The object is to obtain a soil which will bind slightly and not give off moisture too rapidly.

The soil in the tins is then watered, and holes, equidistant and 25 to 30 per tin, are made either with a pointed stick alone or with the assistance of a dibbling board, of a size to fit the tin, with holes about half an inch in diameter spaced as required. A dibbling stick is inserted through these holes into the soil. The tins are now ready for the pricked out seedlings.

The operation of pricking out is best carried out in the shade. It is well previously to construct a simple shade house made of poles, with a loose roof of branches carrying sufficient foliage to allow plenty of light within the structure, at the same time appreciably lessening the intensity of the sun's rays. A portion of the shed should be fitted up with a rough table and have complete shade overhead. The tins containing the soil are placed on the table ready for the seedlings. Seedlings are ready for pricking out when they are about 1½ inches high, and in the case of eucalypts, when they have two to three pairs of leaves. With a spade a clod of earth carrying sufficient seedlings to fill two or three tins is dug out and carried quickly to the table in the pricking out shed. Great care should be taken to expose the roots as little as possible to the air. With a pointed dibbling stick the seedlings are removed from the clod of earth one by one and quickly examined. If the tap root is too long and obviously out of proportion to the rest of the plant, it should be nipped off with the thumb and forefinger, leaving a root which is half as long again as the stem. If the tap root is badly bent, or the seedling otherwise ill-shaped or unhealthy, the plant should be thrown away. The plant, having been examined and found suitable, is inserted into the prepared hole, and the soil is pressed against it from the side with the dibbling stick in such a manner that the root is not bent and that there is no air pocket

at the base of the hole. The seedling should be inserted no deeper than it stood in the nursery bed, *i.e.*, at the collar. A seedling pricked out with a bent tap root, or with the collar deep in the soil, starts with a handicap from which it will never recover. It simply means waste of money, labour, time and a gap in the plantation.

As each tin is filled with plants it is placed in the partial shade of the other part of the shed and watered through a fine rose. Subsequent waterings need only be given when the soil shows signs of drying out. After a week or ten days in the partial shade the tins are placed out in the open sunlight, where the plants are allowed to harden off.

Pricking Out into Beds.—If it is desired to use open-rooted plants, pricking out into transplant beds will ensure better individual root systems than are obtainable with seedlings set out direct from seed-beds. The same treatment and method of preparing the beds are followed as already described. Holes are prepared in the beds with a dibbling stick through a dibbling board in which holes have been bored with an espacement of, say, 2 inches by 3 inches. Tins or clods of earth containing seedlings are carried to the beds, where pricking out is done as before. Temporary and partial shade may be erected over the beds, and may be maintained during the hardening-off process.

Care of Plants Prior to Planting Out.—Plants which have been pricked out into tins or beds, or which have been left in the nursery beds for direct planting, should be watered frequently; dead plants should be replaced and weeding carried out. If planting rains are long delayed and the young plants show a tendency to too rapid growth, this growth should be checked by watering very sparingly. The plants should in effect be made to struggle. The leaves, if the plants are given sufficiently short rations of water, will take on a bluish or brownish colour. This need cause no alarm, as hardy plants will result. On the other hand, this will be the sign that a watering must be given soon in order to keep the young plants alive. If the planting of trees contained in tins is held over for any length of time, periodical inspections should be made by turning over the tins and pruning off all the roots which have come through the drainage holes.

PLANTING IN THE FIELD.

In the planting of young trees it is most important that great care be exercised. Careless planting can be accountable for a large percentage of losses in a plantation, and expenditure incurred in careful planting is money well spent.

Planting Distance.—It has been found generally in this Colony that a planting distance of 6 feet by 6 feet is the most economical and serviceable. This espacement ensures, under normal conditions, the formation of canopy at an early age in the life of the wood. It prevents the formation of heavily branched trees, the timber of which would not be of first quality, and it gives a reasonable margin in allowing for failures and still having a well-stocked stand of established trees. Some slow-growing trees, or trees which have a pyramidal habit of growth, may even be planted 5 feet by 5 feet. Good examples of these trees are the *Callitris calcarata* and *C. robusta*, which, in the tree-veld zones, do not ordinarily form canopy until the fifth year from planting.

The following table gives the number of trees per acre for some of the more common espacements:—

Spacing in feet.	Number per acre.
5 x 5	1,742
6 x 6	1,210
7 x 7	889
8 x 8	681
10 x 10	436
12 x 12	302

Period for Planting.—In theory, planting may be carried out at any time of the year. In practice, however, the planting period in this Colony is confined to the rainy season. The hard experience of many disappointments has shown that in the tree-veld zones—*i.e.*, the regions west of the high eastern border—planting should be left over to the latter half of the rainy season, for two main reasons, *viz.*:—

(i.) The rains in October, November and December are often extremely unreliable, and are generally characterised by thunderstorms and short heavy downpours. Following on the long dry season, the soil is usually so baked that intense

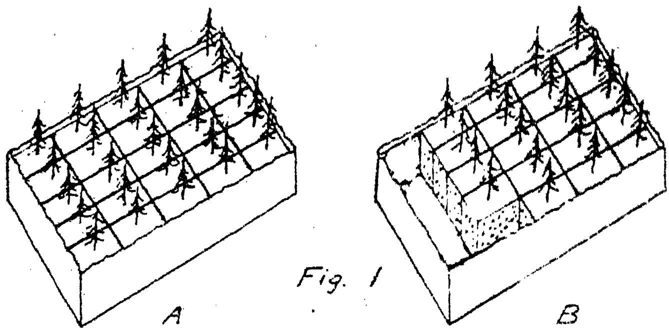


Fig. 1

Cutting cubes and removing from tins.

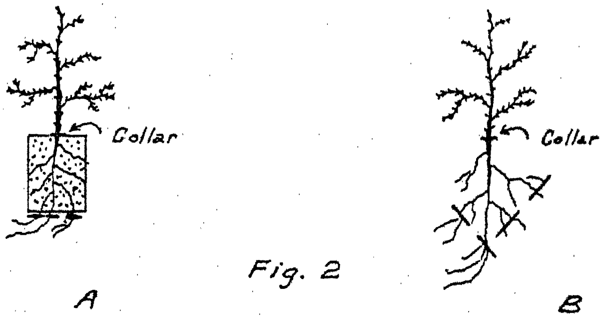


Fig. 2

Root-pruning plants: A: from tins. B: from beds.

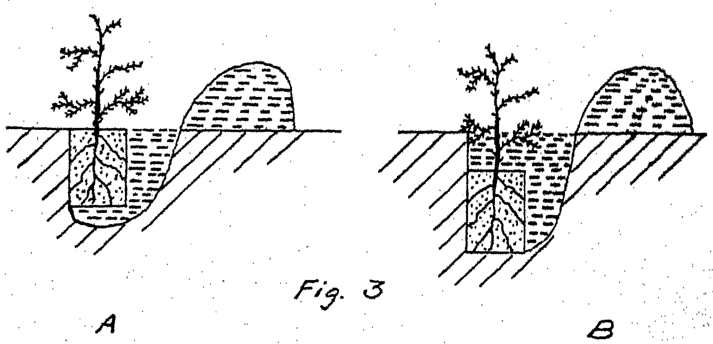


Fig. 3

Planting from tins: A: Right way. B: Wrong way.

evaporation and run-off allow very little moisture to soak into the ground. In consequence, trees planted during favourable weather in these three months have only surface water upon which to draw. This encourages a surface root system. The intra-seasonal droughts, which are common, effect an almost complete drying out of the surface layers of soil, with the result that the young plants are caught high and dry, and if they do not actually succumb, they are so weakened that they fall an easy prey to disease and that ubiquitous scavenger, the termite or "white ant."

As a contrast with this, the rains of January, February and March have a steadier and more persistent fall. The cloudy weather retards evaporation, and run-off is appreciably lessened, with the result that conditions favour the soaking of water into the soil and sub-soil. Young trees planted in such soil have therefore every inducement to develop a strong taproot. When the rains cease and the water table sinks, there is no longer mere inducement to the roots, but actual stern compulsion to follow the sinking water table if life is to be maintained.

(ii.) During the first half of the rainy season the growth of grass and various weeds is particularly vigorous, and unless this is kept in check, often at great expense, the competition with which young trees are called upon to contend is severe and exacting. By the end of January, however, the weed growth has relaxed considerably in vigour, with the result that more food and moisture become available to the recently set out plants.

A consideration of the foregoing will show that planting over the larger portions of the Colony should be confined to the latter part of January to February and March, and even in years of good rainfall, early April.

Planting Weather.—Planting is most successfully carried out on dull, windless and drizzly days, and preferably in late afternoon. Sun and wind produce a less humid atmosphere, which necessitates the exercise of more than ordinary caution in limiting the exposure of the roots of plants to the shortest possible time.

Size and Shape of Plants.—In ordinary forest practice in this Colony, plants should be set out when they are 3 to 6 inches high. The root system should be well balanced in relation to the rest of the plant, and should be well supplied with small fibrous roots. Taproots of undue length should be nipped off to a reasonable length as well as abnormally developed lateral roots (*vide* figs. 2A and 2B). Plants with badly bent taproots (usually the result of bad pricking out) should be thrown away, as sooner or later they will fail in the field.

The smaller the plant set out—say down to 3 inches—the greater are the chances of success, in that there is a smaller root system to disturb and less shock from which to recover when the roots are struggling to establish themselves in their new environment.

It often happens, when favourable planting weather is long delayed, that eucalypts and other fast-growing, broad-leaved trees have reached an alarming size by the time planting is possible. In such cases it is usually advisable to cut back the plants to leave about 6 inches of stem, which may have a few or no leaves remaining. Immediately before actual planting, the root systems should be correspondingly shortened.

When suckers, *e.g.*, of poplar or bamboo, are set out, the same operation of cutting back should previously be carried out.

Planting Methods.—

(*a*) *With Balls of Earth.*—The most common practice in this Colony is to use plants which have previously been pricked out into tins or trays, usually 25 to 30 in a tin.

The tins should be carried to the planting site and well watered. As each tin is to be used, it will facilitate removal of the plants if a sharp knife is drawn between the rows, both across and along the tin. The knife should pierce the soil to the bottom of the tin and also sever the interlacing roots. In this manner each plant stands by itself in a cube of earth.

After the removal of the first cube—in any corner of the tin—the remaining plants are easily removed in succession (*vide* figs. 1A and 1B).

A hole is made in the planting site—by means of a hoe, trowel or flat-pointed stick—slightly larger than is sufficient to receive the ball of earth containing the plant. In removing the ball of earth, a rapid examination for a bad root system should be made, and care should be taken that the earth is not squeezed tightly round the roots.

The ball of earth is held firmly against one side of the hole, so that the base of the stem is on a level with the top of the hole; on no account should the plant be set any deeper. Mother earth is then firmly tamped all round the ball of earth, so that absolute contact is assured. No air spaces must be left, especially at the bottom of the hole. The soil is then firmed down by pressure of the feet, care being taken that no soil is piled above the collar of the plant. If practicable, a little water should be given to the plant to settle it in the soil (*vide* figs. 3A and 3B).

If the ball of earth becomes detached from the roots, the method of open-rooted plants should be followed.

(*b*) *Open-Rooted Plants* (*without Balls of Earth*).—The setting out of open-rooted plants is carried out in the case of seedlings which are removed direct from the nursery beds, when no pricking out has been done, or in the case of transplants, from transplant beds, when the cost of transport to the planting site is a big consideration.

The seedlings or transplants are removed from the beds with a fork or spade in such a manner that the minimum of damage is done to the roots. The plants are packed in a tin containing a sloppy mixture of dung and mud, or sometimes—though this is not advisable in the tree-veld zones—in wet sacks of bags containing some moist moss or other vegetable matter.

At the planting site a hole is made with a hoe, spade or trowel, slightly deeper than the length of the root system of the plant. The plant is removed from the tin or sack and

placed well into the hole. Earth is placed on the bottom of the root, and the plant is then gradually drawn up until the collar is on the level with the top of the hole.

During this operation, which ensures the straightening out of the roots and the natural spreading of the whole system, earth is tamped round the roots until the hole is filled. If care is taken to start tamping at the bottom of the hole, there need be no fear of leaving air spaces to which the roots might be exposed. The soil is firmed and watered as in the method for balled plants.

A quicker method of planting is with the dibbling stick, which is pointed and of square, triangular or circular section. The soil is pierced with the stick and the plant inserted into the resulting hole in such a manner that the taproot is not bent. While the plant is being held in position, the stick is pierced obliquely into the soil a few inches from the first hole. By applying pressure to bring the stick into a vertical position, soil is pressed against the plant and the operation is complete. The disadvantage of this method is that there is no certainty that no air spaces are left at the bottom of the first hole. Many failures are accounted for in this way, especially when raw labour gangs are used in planting operations.

Various methods of planting by "notching" are sometimes used, especially in soils whose texture will allow of a clean cut. "T-notching" is the most common, and is carried out by means of a spade. The spade is inserted into the soil to a depth commensurate with the length of the root of the plant. At one end of the notch or slit so formed the spade is again inserted at right angles. The spade is then tilted back, with the result that the first notch opens out. The plant is then placed in the gap and the spade withdrawn. The earth will tend to subside into its original position, but assistance should be given by pressure of the feet to ensure that no air spaces are left.

In the tree-veld zones the dibbling and notching methods are not advocated. Skill and understanding are needed in carrying out the operations. In any case, the roots assume

an unnatural position in the soil, and in a country where tree planting is fraught with numerous pitfalls, any method which is inimical to the formation of a normal root system should be avoided.

All methods of setting out open-rooted plants are subject to appreciable failures, namely, by reason of the fact that roots are more liable to exposure to the air than when balled plants are used. Unless, therefore, keen supervision of planting is exercised, it may well be that the initial low cost of such operations will, by reason of repeated subsequent filling of blanks, eventually equal the expense which would have been incurred by planting with balls of earth.

CLEANLINESS AIDS INSECT CONTROL

in Lands and Sheds, Stores and Farmsteads.

Rhodesia Weather Bureau.

SEPTEMBER, 1938.

Pressure.—Mean barometric pressure was slightly above normal.

Temperature.—Both temperature and humidity were close to the average over the whole country.

Rainfall.—The usual slight amounts of precipitation were recorded at most stations during the month.

PRECIPITATION.

Station.	Inches.	Normal.	No. of Days.
Beitbridge	0.47	0.15	4
Bindura	Nil	0.12	—
Bulawayo	Nil	0.17	—
Chipinga	0.43	0.76	5
Enkeldoorn	Nil	0.14	—
Fort Victoria	0.06	0.20	3
Gwaai Siding	0.07	0.12	2
Gwanda	0.03	0.14	2
Gwelo	0.02	0.17	1
Hartley	0.10	0.10	1
Inyanga	0.17	0.21	1
Marandellas	Nil	0.26	—
Miami	Nil	0.02	—
Mount Darwin	Nil	0.07	—
Mount Nuza	0.61	0.90	6
Mtoko	0.02	0.03	1
New Year's Gift	0.30	0.25	3
Nuanetsi	0.91	0.17	4

Station.	Inches.	Normal.	No. of Days.
Plumtree	Nil	0.03	—
Que Que	Nil	0.07	—
Rusape	Nil	0.17	—
Salisbury	Nil	0.26	—
Shabani	0.03	0.28	1
Sinoia	Nil	0.19	—
Sipolilo	Nil	0.11	—
Stapleford	0.75	0.82	4
Umtali	0.08	0.38	3
Victoria Falls...	0.11	0.01	1
Wankie	Nil	0.03	—
Abercorn	Nil	—	—
Broken Hill	Nil	—	—
Choma	Nil	—	—
Fort Jameson	Nil	—	—
Fort Roseberry	Nil	—	—
Isoka	Nil	—	—
Kalomo...	Nil	—	—
Kanchindu	Nil	—	—
Kapiri Mposhi	Nil	—	—
Kasama	Nil	—	—
Kasempa...	Nil	—	—
Livingstone...	0.05	—	1
Lundazi...	Nil	—	—
Lusaka	Nil	—	—
Mankoya...	Nil	—	—
Mazabuka	Nil	—	—
Mongu	Nil	—	—
Mpika	Nil	—	—
Mporokoso...	Nil	—	—
Mufulira	Nil	—	—
Mumbwa	Nil	—	—
Mwinilunga	0.29	—	4
Namwala	Nil	—	—
Ndola	Nil	—	—
Petauke	Nil	—	—
Senanga	0.03	—	1
Sesheke	0.02	—	1
Solwezi	Nil	—	—

SEPTEMBER, 1938

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	Wet Bulb.	Dew Point	Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Beitbridge...	1,500	69.0	60.1	54	10.0	85.2	58.8	72.0	98	12	47	4	15	3	4	...	72.4	967.8	885.6	...	3.0	...
Bindura...	3,700	67.3	56.5	48	11.4	82.7	54.8	68.7	89	16	45	4	6	...	...	...	68.7	894.5	884.4	...	0.9	...
Bulawayo	4,393	65.0	53.4	43	11.6	81.4	53.2	67.3	89	12	39	16	11	3	...	1	67.3	871.9	883.5	870.1	2.1	10.1
Chipinga	3,685	65.4	57.1	50	8.6	77.1	53.2	65.2	89	12	45	17	6	7	...	...	63.8	895.7	885.0	...	2.1	...
Enkeldoorn	4,788	64.9	53.2	42	11.8	79.5	51.7	65.6	89	12	42	17	2	2	...	...	65.5	860.0	883.9	...	1.1	...
Fort Victoria... ...	3,571	65.4	55.3	47	10.4	81.8	52.0	66.9	92	12	41	4	12	2	...	...	67.0	898.2	884.0	896.5	2.4	...
Gwaai Siding... ...	3,278	68.9	56.4	46	13.5	91.5	52.3	71.9	98	1	42	17	27	...	...	...	...	906.9	883.2	...	1.3	...
Gwanda...	3,233	66.8	55.8	47	11.5	82.3	56.6	69.5	92	var.	46	19	13	4	1	...	69.6	908.9	883.8	...	2.0	...
Gwelo	4,629	65.4	53.9	43	11.6	80.8	52.4	66.6	88	12	42	17	7	3	...	...	66.8	864.8	883.8	...	1.7	...
Hartley...	3,879	68.3	55.0	43	14.0	84.6	52.9	68.7	91	12	42	17	14	...	...	...	68.9	887.9	883.3	...	0.5	...
Inyanga...	5,503	66.3	53.6	41	12.8	76.0	49.1	62.6	84	12	38	5	...	1	...	2	61.5	...	...	...	0.8	...
Marandellas	5,453	63.5	52.6	42	10.9	76.7	51.4	64.1	85	12	39	4	...	1	...	1	62.7	...	...	...	1.1	...
Miami	4,090	67.4	56.9	48	11.1	81.7	53.3	67.5	88	12	44	17	2	...	...	...	67.3	880.8	882.8	879.1	0.6	...
Mt. Darwin	3,179	68.7	58.3	51	11.2	84.1	55.3	69.7	91	16	43	6	13	...	...	...	69.7	...	...	...	2.3	...
Mount Nuza	6,668	54.6	48.3	41	5.5	63.4	47.1	55.3	73	15	37	17	...	28	...	1	54.2	803.6	884.4	...	3.9	...
Mtoko	4,141	66.9	55.8	46	11.6	76.8	55.8	66.3	84	12	48	17	...	1	...	...	65.9	880.5	884.1	878.8	1.0	..
New Year's Gift...	2,690	66.2	58.4	53	8.4	82.0	53.4	67.7	94	15	47	17	10	3	...	...	...	...	...	...	...	8.3
Nuanetsi	1,581	69.4	61.4	56	9.0	84.3	56.0	70.2	98	12	43	5	17	3	...	...	...	965.8	885.8	...	3.5	...

SEPTEMBER, 1938 (continued)

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m.: Dry Bulb.	Wet Bulb.	Dew Point	Vapour Press Deficit	Maximum	Minimum	Max. + Min. ÷ 2	Absolute: Maximum	Date	Minimum	Date	Number of Days: Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Plumtree	4,549	66.9	53.4	40	13.8	81.3	56.2	68.7	88	var.	44	17	8	2	1	...	67.6	...	...	...	0.7	...
Que Que	3,999	66.7	55.2	45	11.9	83.5	53.8	68.6	90	12	45	17	13	1	...	...	...	884.3	883.5	882.3	0.8	...
Rusape	4,648	63.9	53.9	45	10.0	78.7	48.4	63.5	89	12	36	4	1	1	..	1	63.6	..		...	1.5	...
Salisbury	4,831	65.6	53.8	43	11.9	79.6	52.0	65.8	88	12	41	17	1	...	...	...	65.6	858.7	883.6	857.0	1.0	10.5
Shabani	3,131	67.6	57.0	49	11.3	83.9	55.6	69.7	94	12	47	5	13	1	...	...	69.1	...	...	...	2.5	...
Sinoia	3,795	68.6	56.9	48	12.1	85.0	50.7	67.9	92	12	38	5	18	...	...	1	69.1	...	...	...	0.8	...
Sipolilo	3,876	70.0	58.1	49	13.0	81.8	57.0	69.4	90	10	49	17	2	...	...	...	...	...	...	...	1.5	...
Stapleford	5,304	58.9	52.9	47	5.7	68.5	44.4	56.4	80	12	30	5	...	13	...	8	56.0	...	...	...	3.1	...
Umtali	3,672	64.4	57.3	52	7.7	79.6	54.7	67.1	91	12	45	5	5	5	...	...	65.7	896.2	885.1	894.5	3.4	...
Victoria Falls... ...	3,009	72.5	57.1	44	18.0	92.6	58.5	75.5	100	15	49	16	28	...	...	...	75.9	...	...	...	0.3	...
Wankie...	2,569	75.3	59.3	47	19.8	93.5	64.8	79.1	99	12	51	17	28	...	15	...	79.5	928.3	882.9	...	0.3	...
Abercorn	5,407	66.7	55.9	48	11.2	82.0	57.1	69.6	86	18	50	2	1	...	...	...	...	838.1	881.5	...	0.6	...
Broken Hill	3,920	68.6	56.1	45	13.4	85.4	59.5	72.4	89	12	54	17	20	...	1	...	...	885.5	881.7	...	1.1	...
Chipili	3,900	66.9	57.7	51	9.9	91.2	57.7	72.9	94	18	45	1	28	...	...	...	...	...	...	...	...	...
Fort Jameson ...	3,620	71.4	58.8	50	14.1	84.7	62.8	73.8	91	16	54	2	15	...	7	...	...	889.8	883.3	...	0.8	...
Kasama...	4,700	68.5	57.5	49	11.8	85.5	58.1	71.8	90	16	54	3	21	...	...	...	...	865.1	881.7	...	...	...
Kasempa	4,500	68.2	56.4	48	12.5	87.0	54.8	70.9	91	13	47	6	24	...	...	...	...	...	...	...	...	...
Livingstone	3,140	67.9	54.5	43	14.0	92.1	59.7	75.9	93	15	49	17	28	...	3	...	76.5	912.7	882.1	910.4	0.6	...
Lusaka	4,193	69.9	57.1	47	13.9	83.6	58.9	71.3	89	12	50	17	11	...	1	...	...	876.5	881.8	...	1.7	...
Mazabuka Res. ...	3,385	71.6	57.9	47	15.6	87.7	62.8	75.3	93	12	50	17	21	...	9	...	...	901.7	882.2	...	0.7	...
Mongu	3,475	72.1	58.4	48	15.7	96.2	63.0	79.6	101	23	45	17	30	...	13	...	...	897.6	880.5	...	1.1	...
Mpika	4,625	68.3	56.6	47	12.5	81.8	57.4	69.6	88	17	51	2	2	...	...	...	...	863.8	882.2	...	0.8	...
Mwinilunga	4,450	64.5	55.4	48	9.0	86.7	53.8	70.3	90	14	50	1	25	...	...	...	...	...	...	...	...	...
Ndola	4,140	67.8	56.7	48	11.8	87.0	56.5	71.8	92	12	52	2	23	...	...	...	...	876.7	881.7	...	0.7	...

Southern Rhodesia Veterinary Report.

AUGUST, 1938.

DISEASES.

Three cases of rabies, confirmed by biological tests, occurred amongst dogs at the Victoria Falls, otherwise no fresh outbreaks of scheduled diseases occurred.

TUBERCULIN TEST.

Seven bulls and 9 cows were tested upon importation with negative results.

MALLEIN TEST.

Twenty-seven horses and 12 mules were tested during the month. No reactions.

IMPORTATIONS.

From Union of South Africa.—Bulls 2, cows 9, horses 19, mules 12, sheep 67.

From Northern Rhodesia.—Horses 2.

From Bechuanaland Protectorate.—Sheep 1,714, goats 50.

From United Kingdom.—Bulls 5.

EXPORTATIONS.

To Union of South Africa.—Oxen 443, cows 30, horses 2.

To Northern Rhodesia.—Horses 1, mules 1.

To Portuguese East Africa.—Oxen 39.

To Congo Belge.—Sheep 60.

EXPORTATIONS—MISCELLANEOUS.

To United Kingdom.—Chilled beef quarters, 8,271; frozen boned beef quarters, 813; frozen pork carcases, 42; kidneys, 78 lbs.; tongues, 210 lbs.; livers, 998 lbs.; hearts, 86 lbs.; skirts, 89 lbs.; shanks, 35 lbs.

To Congo Belge (in cold storage).—Beef carcases, 539¼; mutton carcases, 23; veal carcases, 26; chickens, boxes, 8; rabbits, cases, 1.

Meat Products.—From Liebig's Factory:—

To Union of South Africa.—Corned beef, 52,372 lbs.; beef fat, 22,800 lbs.; tongues, 2,880 lbs.

To United Kingdom.—Meat extract, 22,073 lbs.; beef powder, 71,927½ lbs.

To Northern Rhodesia.—Meat meal, 2,000 lbs.

B. L. King,
for Actg. Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-38.

Monthly Report No. 70. September, 1938.

Numerous swarms of the Red Locust (*Nomadacris septemfasciata*, Serv.) have been reported during the month. Reports have been received from eleven districts in Mashonaland, namely, Lomagundi, Melsetter, Inyanga, Rusapi, Sebungwe, Umtali, Bikita, Hartley, Gutu, Makoni and Chibi; and from five districts in Matabeleland, namely, Gwelo, Bulalima-Mangwe, Bulawayo, Selukwe and Matobo.

Many of the swarms have been described as large. There appears to be a general tendency for the swarms to move in a southerly direction. The Melsetter district has been invaded by many swarms from Portuguese East Africa. Some damage to winter crops and fruit trees have been notified.

The development of colour has passed the deepest red stage.

J. K. CHORLEY,
Acting Chief Entomologist.

Departmental Bulletins.

The following Bulletins are available for distribution at 3d. per copy. Application should be made to the Editor, Department of Agriculture, Salisbury, and remittances must accompany orders.

N.B.—The date the article appeared in the Journal is indicated in abbreviated form before the number, e.g., 8/22, No. 429, means that Bulletin 429 appeared in the Journal for August, 1922.

AGRICULTURE AND CROPS.

3/31. No. 815. New Strains of Oats for Southern Rhodesia, by H. C. Arnold, Manager, Agricultural Experiment Station, Salisbury.

4/31. No 816. Preliminary List of the more Common Grasses of Southern Rhodesia, by Sydney M. Stent, Botanist for Pasture Research.

5/31. No. 822. Re-stacking of Maize rejected for Export on account of Excessive Moisture.

9/31. No. 826. Some Poisonous Plants of Southern Rhodesia, by Sydney M. Stent, Senior Botanist.

10/31. No. 831. Revised Notes on Cotton Growing in Southern Rhodesia, by G. S. Cameron.

11/31. No. 836. The Potato, by S. D. Timson, M.C., Dip.Agric. (Wye).

12/31. No. 837. Veld Grass Silage: A Feature in Rhodesian Pasture Management, by H. G. Mundy, Dip.Agric. (Wye), F.L.S., Chief, Division of Plant Industry.

6/32. No. 855. Pigeon-hole Method of Stacking Maize, by Division of Plant Industry.

8/32. No. 859. Twenty-one Years of Plant Introduction, by Major Mundy, Chief Division of Plant Industry.

2/33. No. 878. A.I.V. Silage: Memorandum prepared and circulated by Imperial Bureau of Animal Nutrition.

11/34. No. 936. Witchweed, by S. D. Timson, M.C. Dip.Agric. (Wye), Assistant Agriculturist.

10/35. No. 970. Rhodes Grass for the Southern Rhodesian Tobacco Grower, by African Explosives and Industries, Ltd.

11/35. No. 972. Notes on Witchweed, by S. D. Timson, M.C., Dip.Agric. (Wye), Assistant Agriculturist.

6/36. No. 992. Annual Report of the Agriculturist for the year 1935, by D. E. McLoughlin, Agriculturist.

7/36. No. 994. Some Notes on Cotton Growing, by J. E. Peat, Senior Plant Breeder, Cotton Station, Gatooma.

4/37. No. 1022. Smut Diseases of Wheat in Southern Rhodesia, by G. M. Wickens, B.Sc. Agric., Ph.D., D.I.C., Plant Pathologist, Tobacco Research Station, Trelawney.

10/37. No. 1046. Green Manuring: Two Important Factors Affecting Success, by S. D. Timson, M.C., Assistant Agriculturist, and H. C. Arnold, Manager, The Agricultural Experiment Station.

10/38. No. 1084. Improved Pastures, by S. D. Timson, M.C., Assistant Agriculturist.

REPORTS ON CROP EXPERIMENTS.

7/27. No. 649. Annual Report of Experiments, 1925-26, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Manager.

4/28. No. 683. Annual Report of Experiments, 1926-27, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Station Manager.

7/29. No. 745. Salisbury Agricultural Experiment Station Annual Report, 1927-28, by H. C. Arnold.

7/30. No. 789. Agricultural Experiment Station, Salisbury. Annual Report of Experiments, 1928-29, by H. C. Arnold.

9/31. No. 830. Salisbury Agricultural Experiment Station, Annual Report, 1929-30, by H. C. Arnold, Manager.

10/32. No. 864. Annual Report, 1930-31: Agricultural Experiment Station, by H. C. Arnold, Station Manager.

6/33. No. 895. Salisbury Agricultural Experiment Station Annual Report, 1931-32, by H. C. Arnold, Manager.

3/34. No. 914. Gwelo Municipal Demonstration Station: Final Report, 1933, by S. D. Timson, M.C., Dip.Agric. (Wye), Assistant Agriculturist.

9/35. No 965. Salisbury Agricultural Experiment Station Annual Report, 1933-34, by H. C. Arnold, Manager.

TOBACCO.

8/26. No. 605. Flue-curing Tobacco Barns, Bulking and Grading Sheds, by P. H. Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.

9/26. No. 615. The Culture of Virginia Tobacco in Southern Rhodesia: Field Management, by D. D. Brown.

5/27. No. 641. The Handling, Grading and Baling of Cured Virginia Tobacco, by D. D. Brown.

5/27. No. 644. Tobacco Baling Boxes, by B. G. Gundry, Irrigation Branch.

9/27. No. 653. The Care of Tobacco Seed Beds, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad)

11/27. No 661. Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16 ft., by B. G. Gundry.

1/28. No. 665. Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.

2/28. No. 671. Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.

12/28. No. 715. Turkish Tobacco Culture in Southern Rhodesia, by D. D. Brown, Chief Tobacco Expert.

3/29. No. 728. Suggested Crop Rotations for Tobacco Growers, by D. D. Brown, Chief Tobacco Expert.

4/29. No. 734. Common Faults in Curing Virginia Bright Tobacco, by D. D. Brown, Tobacco and Cotton Expert.

8/29. No. 748. Frog Eye Disease of Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

9/29. No. 753. Leaf Spotting of Tobacco caused by Mosaic, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

2/30. No. 771. Dark Fire-cured Tobacco: Field Operations, by D. D. Brown, Chief Tobacco Expert.

3/30. No. 774. Dark Fire-cured Tobacco: Harvesting and Curing, by D. D. Brown, Chief Tobacco Expert.

6/30. No. 784. Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.

3/31. No. 812. Selection of Tobacco Seed Plants, by H. F. Ellis, M.Sc., B.S. (Agric.), Tobacco Adviser.

11/31. No. 835. Tobacco Culture: Transplanting Operations, by D. D. Brown.

3/32. No. 846. Leaf Curl in Tobacco, by Dr. H. H. Storey.

3/33. No. 885. Tobacco Culture in Southern Rhodesia: The Harvesting and Curing of Virginia Tobacco, by D. D. Brown, Chief Tobacco Officer.

8/36. No. 996. The "Gundry" Tobacco Furnace, by B. G. Gundry, A.I.Mech.E.

12/36. No. 1009. Tobacco Research on the Trelawney Station 1935-36 Season.

4/37. No. 1025. Report of the Tobacco Research Board, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture and Chairman of the Tobacco Research Board.

5/37. No. 1026. Notes on Tobacco Root-Knot Nematode, by J. C. Collins, B.Sc., Biologist, Trelawney Tobacco Research Station.

8/37. No. 1039. Some Tobacco Pests that can be serious, by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.

1/38. No. 1054. Alkalinity of Tobacco Seed-bed Soils, by A. P. Taylor, M.A., B.Sc., Agricultural Chemist.

3/38. No. 1063. A New and Serious Disease of Tobacco in Southern Rhodesia, by G. M. Wickens, Ph.D., D.I.C., Plant Pathologist, Tobacco Research Station, Trelawney.

5/38. No. 1070. A Witchweed on Tobacco Roots (*Striga orobanchoides*, Benth.), by Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

6/38. No. 1072. Report of the Tobacco Research Board for the year ending 31st December, 1937, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture, and Chairman of the Tobacco Research Board.

LIVE STOCK.

1/27. No. 624. The Construction of Dipping Tanks for Cattle (Revised).

1/31. No. 801. Sheep Farming in the Melsetter District, by J. C. Kruger, Part-time Sheep Adviser in the Melsetter District.

10/32. No. 863. Piggeries, by B. G. Gundry, A.I.Mech.E.

12/32. No. 871. Some General Observations on the Feeding of Dairy Cows on a Mixed Stock Farm, by Dr. A. E. Romyn, Senior Animal Husbandry Officer.

4/33. No. 887. The Type of Chiller Steer required for Export, by A. E. Romyn, Senior Animal Husbandry Officer.

9/33. No. 903. The Handling, Preparation and Chilling of Cattle for Export, by C. A. Murray, Lecturer in Animal Husbandry.

12/33. No. 907. The Blackhead Persian: Its Breeding and Management in Matabeleland, by C. A. Murray, M.Sc., Lecturer in in Animal Husbandry, Matopo Estate.

1/34. No. 909. Stall Fed Chillers for the Overseas Christmas Market, by C. A. Murray, M.Sc., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.

2/34. No. 912. Economical Winter Rations for Wintering Dairy Heifers, by C. A. Murray, M.Sc. (Agric), Lecturer in Animal Husbandry, Matopo School of Agriculture.

4/34. No. 916. Cowpea Hay in the Ration for Bacon Pigs, by C. A. Murray, M.Sc. (Agric.), Lecturer in Animal Husbandry, Matopo School of Agriculture and Experiment Station.

6/34. No. 924. Raising Dairy Calves on a Limited Amount of Whole Milk, by C. A. Murray, M.Sc., Agr., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.

1/35. No. 943. Cattle Improvement and a Cattle Breeding Policy in Southern Rhodesia: A Review of the General Position Chiefly as regards Ranching Cattle, by Dr. A. E. Romyn, Chief Animal Husbandry Officer.

1/35. No. 945. A Home-made Cow Stanchion, by Major R. R. Sharp, Whinburn, Redbank.

3/35. No. 946. Economical Rations for Wintering Dairy Cattle, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station.

5/35. No 952. Annual Report of the Chief Animal Husbandry Officer for the year ending 31st December, 1934, by A. E. Romyn, Chief Animal Husbandry Officer.

7/35. No. 959. The Selection of a Dairy Bull, by A. E. Romyn, Ph.D., Chief Animal Husbandry Officer.

4/36. No. 984. Report on the Curing of Rhodesian Hides, by Advisory Committee on Hides and Skins of the Imperial Institute.

4/36. No 985. Export of Frozen Porkers. Third Consignment to Smithfield. Division of Animal Husbandry.

5/36. No. 987. The Curing of Hides and Skins on the Farm, by The Division of Animal Husbandry.

5/36. No. 988. Preparing Cattle for Show, by The Animal Husbandry Division.

6/36. No. 989. The Supplementary Feeding of Mineral and Protein Supplements to Growing Cattle in Southern Rhodesia and its Relation to the Production of Beef Steers, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E. Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Southern Rhodesia; D. G. Haylett, Ph.D., Director, Rhodes Matopo Estate; F. Ericksen, Dip. Agric., Experimentalist.

10/36. No. 1001. The Raising of Bacon Pigs, by A. E. Romyn, Chief Animal Husbandry Officer, and C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate, with a Veterinary Section by D. A. Lawrence, Director of Veterinary Research.

9/36. No. 1000. Sheep Management on the Mixed Farm, by R. H. Fitt, Animal Husbandry Officer.

4/37. No. 1023. Cowpea Molasses Silage for Fattening Steers, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station; A. E. Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Salisbury; R. H. Fitt, Dipl. Agric., Animal Husbandry Officer, Department of Agriculture, Salisbury.

4/37. N. 1024. Comparative Feeding Value of Maize Meal and Nyouti (*Pennisetum Typhoides*) Meal for Fattening Steers, by C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E. Romyn, Chief Animal Husbandry Officer.

5/37. No. 1027. The Feeding of Phosphorus Supplements to Growing Cattle, by C. A. Murray and A. E. Romyn.

5/37. No. 1029. The Dehorning of Cattle intended for Slaughter and Export, by B. A. Myhill, Assistant Chief Veterinary Surgeon.

5/37. No. 1030. The Feeding of Different Winter Supplements to young growing steers and the effect of these supplements on the subsequent development and costs of production of the steers, by C. A. Murray and A. E. Romyn.

6/37. No. 1032. The Effects of Feed on the Firmness and Grading of Bacon Carcases, an experiment carried out by the Division of Animal Husbandry in co-operation with Mr. A. L. Millar, Estes Park, Salisbury, and Mr. Frank Neill, of Neill's Bacon Factory, Salisbury.

6/37. No. 1034. Nyouti or Munga (*Pennisetum typhoides*) as a Feed for Bacon Pigs, by C. A. Murray and A. E. Romyn.

7/37. No. 1036. Preliminary Report on the Feeding of Winter Supplements to young growing steers and the effect of supplementary feeding on the subsequent development of these animals, by C. A. Murray and A. E. Romyn.

12/37. No. 1049. The Export of Frozen Porkers: Report on Five Consignments of Porkers Exported to Smithfield, by Division of Animal Husbandry.

1/38. No. 1053. The Feeding of Sunnhemp Hay as compared with Cowpea Hay in the Fattening Ration for Bullocks, by A. E. Romyn and R. H. Fitt.

2/38. No. 1058. Pig Industry Act, 1937. Division of Animal Husbandry.

3./38. No. 1062. Protein Supplements for Fattening Bullocks, by A. E. Romyn and R. H. Fitt.

9/38. No. 1083. Internal Parasites in Sheep, by Percy D. Huston, M.R.C.V.S., District Veterinary Officer.

DAIRYING.

12/30. No. 799. The Objects of Ripening Cream for Butter-making, and a few Hints on Cream Production, by F. Lammas, Dairy Officer.

4/31. No. 818. Farm Butter-making. Issued by the Dairy Branch.

9/32. No. 862. Cream Cheese, by F. A. Lammas, Dairy Officer.

3/33. No. 880. Dairy Tests and Calculations, by F. A. Lammas, Dairy Officer.

5/34. No. 922. Dairy Building in Southern Rhodesia: A Small Farm Dairy, by G. B. Gundry, A.I.Mech.E.

7/34. No. 926. Dairy Buildings in Southern Rhodesia. Cow Byre—Type II., by B. G. Gundry, A.I.Mech.E.

12/34. No 937. Gouda or Sweet Milk Cheese, by F. Lammas, District Dairy Officer.

2/36. No. 977. Notes on the Feeding of Dairy Cows during the Summer Months, by A. E. Romyn, Chief Animal Husbandry Officer.

6/36. No. 990. Southern Rhodesia Milk Recording Scheme.

12/37. No. 1051. The Production and Handling of Milk and Cream, by the Dairy Branch.

VETERINARY.

10/14.	No.	191.	Scab or Scabies in Sheep and Goats, by Rowland Williams, M.R.C.V.S.
4/25.	No.	536.	Inoculation of Cattle against Redwater and Gall Sickness, by Ll. E. W. Bevan, M.R.C.V.S.
12/25.	No.	570.	The Spaying of Bovines, by G. C. Hooper Sharpe, M.C., M.R.C.V.S., and M. H. Kingcombe, M.R.C.V.S.
6/26.	No.	597.	Suspected Poisoning of Stock: The Proper Procedure, by M. H. Kingcombe, M.R.C.V.S. (Lond.), and A. W. Facer, B.A. (Oxon.), A.I.C.
12/26.	No.	618.	Notes from the Veterinary Laboratory: Quarter Evil, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.
1/28.	No.	666.	Notes from the Veterinary Laboratory: Praemonitus—Praemunitus, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.
4/29.	No.	739.	The Laboratory Diagnosis of Animal Diseases: A Note to Emphasise some Points in the Preparation and Forwarding of Specimens, by D. A. Lawrence, B.V.Sc., Veterinary Research Officer.
10/29.	No.	756.	Parasitic Gastritis of Cattle, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.
11/29.	No.	760.	A Note on Sheep Diseases in Southern Rhodesia, by D. A. Lawrence, B.V.Sc., Veterinary Research Officer, Department of Agriculture, Salisbury.
2/30.	No.	772.	Notes from the Veterinary Laboratory: Ophthalmia, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.
4/31.	No.	819.	Measles in Swine, by P. D. Huston, M.R.C.V.S.
1/32.	No.	841.	Poisonous or Suspected Poisonous Plants of Southern Rhodesia: Tulip Poisoning of Cattle, by Sydney M. Stent, Senior Botanist, and D. A. Lawrence, B.V.Sc., Veterinary Research Officer.
10/32.	No.	866.	The Treatment of Intestinal Parasites of Sheep, by J. D. Coutts, D.V.S., M.R.C.V.S.
4/33.	No.	886.	A Preliminary Note on Contagious Granular Vaginitis in Southern Rhodesia, by D. A. Lawrence, B.V.Sc., Acting Director Veterinary Research.
5/34.	No.	921.	Myiasis (Screw-Worm) in Cattle in Southern Rhodesia, by D. A. Lawrence, Director of Veterinary Research, and A. Cuthbertson, Entomologist.

IRRIGATION, WATER SUPPLIES AND SOIL EROSION.

3/27.	No.	633.	The Cost of Pumping for Irrigation, by R. H. Roberts, B.Sc. (Eng.).
4/27.	No.	640.	Levelling for Irrigation, by Dr. W. S. H. Cleghorn, M.I.Mech.E.
11/27.	No.	659.	The Hydraulic Ram, revised by P. H. Haviland, B.Sc.
11/28.	No.	668.	The Water Act, 1927, by C. L. Robertson, B.Sc. (Eng.), A.M.I.C.E.
1/28.	No.	670.	Irrigation Canals, by P. H. Haviland, B.Sc. (Eng.).
6/30.	No.	786.	Low Concrete Dams, by R. Hamilton Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.
2/31.	No.	808.	The Application of Water in Irrigation, by R. Hamilton Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

3/31.	No 811.	Irrigation Canal Structures, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.
8/32.	No. 860.	Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.
2/33.	No. 879.	Conditions Governing the Hire of Government Boring Machines.
8/33.	No. 900.	Three Types of Water Tank, by R. H. Roberts, B.Sc. (Eng.), A.M.I.C.E., Assistant Irrigation Engineer.
6/35.	No. 956.	Annual Report of the Division of Irrigation for the year ended 31st December, 1934, by P. H. Haviland, B.Sc. (Eng.), Acting Chief Irrigation Engineer.
9/35.	No. 964.	The Use of Ditchers for Constructing Contour Ridges, by C. Tapson, Devondale, Concession.
9/35.	No. 967.	How to use an Engineer's or Farm Level, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E., Irrigation Engineer (Matabeleland).
12/35.	No 973.	Domestic Water Supplies and Sanitation on the Farm, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E., Irrigation Engineer (Matabeleland).
3/36.	No. 980.	Results from Glenara Soil Conservation Experiment Station, 1934-35 Season, by C. L. Robertson, B.Sc. A.M.I.C.E., Chief Engineer, Irrigation Division, and A. D. Husband, F.I.C., Chief Chemist.
8/36.	No. 999.	Lining an Irrigation Furrow, by R. H. Roberts, B.S., A.M.Inst.C.E., Assistant Irrigation Engineer.
3/37.	No. 1019.	Soil Conservation, by D. Aylen, Esq., Outside Technical Assistant, and R. Hamilton Roberts, B.Sc., A.M.Iinst.C.E., Irrigation Engineer.
1/38.	No. 1052	Small Earthen Storage Dams. Part I. By the Irrigation Division.
2/38.	No. 1055.	Small Earthen Storage Dams. Part II. By the Irrigation Division.
3/38.	No. 1061.	Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.
7/38.	No. 1077.	A Small Brick Irrigation Furrow, by H. W. H. Wallis, Assistant Irrigation Engineer.

FORESTRY.

11/29.	No 763.	The Utilisation of Wood, by T. L. Wilkinson, M.Sc., B.Sc.F.
1/30.	No. 769.	The Utilisation of Wood, by T. L. Wilkinson, M.Sc., B.Sc.F.
4/30.	No. 778.	The Utilisation of Wood in Southern Rhodesia—Conversion and Disposal of Timber, by T. L. Wilkinson, M.Sc., B.Sc.F., District Forest Officer.
8/30.	No. 791.	The Utilisation of Wood in Southern Rhodesia: Fencing, by T. L. Wilkinson, M.Sc., B.Sc.F., District Forest Officer.
2/31.	No. 809.	Establishing Pines: Preliminary Observations on the Effects of Soil Inoculation. Issued by the Division of Forestry.
4/31.	No. 817.	The Raising of Forest Seedlings and Transplants on the Farm, by E. J. Kelly Edwards, M.A., Dip.For. (Oxon.), Acting Chief Forest Officer.

7/32.	No. 857.	Charcoal Burning on the Farm, by R. J. Allen, Forester, Rhodes Matopo School of Agriculture and Experiment Station.
11/32.	No 869.	Wind-breaks and Shelter Belts, by A. A. Pardy, B.Sc., Forestry.
1/33.	No. 874.	Tree Planting, by the Division of Forestry.
4/33.	No. 888.	The Vegetable Ivory Palm (Hyphoene ventricosa), by G. M. McGregor, B.Sc., District Forest Officer, Matabeleland.
8/34.	No. 927.	Some Facts about Tung Oil, by R. H. Finlay, B.A., Dip. For. (Oxon.), District Forest Officer.
8/34.	No. 928.	Some Trees, Shrubs, Shrubby-Herbaceous Plants, Climbers and Water Plants suitable for the Colony, by J. W. Barnes, Manager, Government Forest Nursery, Salisbury.
12/35.	No. 974.	Summary of the Annual Report of the Division of Forestry for the year 1934, by E. J. Kelly-Edwards, M.A., Dip. For. (Oxon.), Chief Forest Officer.
		Price List of Forest-tree Transplants, Ornamental Trees Shrubs, Hedge Plants, Creepers and Seeds obtainable at the Government Forest Nursery, Salisbury.
3/37.	No. 1020.	The Raising of Forest Seedlings and Transplants on the Farm, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.
10/37.	No. 1045.	Seventeenth Annual Report of the Division of Forestry for the Year 1936, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.
6/38.	No. 1073.	Pruning of Plantations, by R. H. Finlay, B.A., Oxon., Division of Forestry.
7/38.	No. 1076.	Eighteenth Annual Report of the Division of Forestry for the year 1937, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.
10/38.	No. 1085.	The Pot Planting of Eucalypts, by Major G. R. Wake, Vigila, Umvukwes.

HORTICULTURE

4/27.	No. 637.	Harvesting, Packing and Marketing of Deciduous and Tropical Fruits, by G. W. Marshall, Horticulturist.
8/27.	No. 650.	Coffee Culture in Southern Rhodesia, by G. W. Marshall, Horticulturist.
2/29.	No 725.	Investigations into "Collar-Rot" Disease of Citrus, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad)
3/31.	No. 814.	Avocado Growing in South Africa, by Redvers J. Blatt, B.Sc., Ph.D.
11/31.	No. 834.	Celery Culture, by G. W. Marshall, Horticulturist.
1/32.	No. 843.	Vegetable Growing in Southern Rhodesia: Onion Culture, by G. W. Marshall, Horticulturist.
2/33.	No. 876.	Notes on African Aloes (Parts 1-6), by H. Basil Christian, "Ewanrigg," Arcturus.
10/33.	No. 905.	Notes on African Aloes (Parts 7-10), by H. Basil Christian, "Ewanrigg," Arcturus.
5/34.	No. 920.	Citrus Fruit Growing in Rhodesia, by G. W. Marshall, Horticulturist.
5/37.	No. 1028.	Tomato Culture in Southern Rhodesia, by G. W. Marshall, Horticulturist.
9/37.	No. 1043.	The Rhodesian Home Orchard, by G. W. Marshall, Horticulturist.

ENTOMOLOGY AND PLANT PATHOLOGY.

2/13.	No. 139.	Termites, or "White Ants," by Rupert W. Jack, F.E.S
6/15.	No. 214.	Some Household Insects, by R. Lowe Thompson, B.A.
2/21.	No 385.	The Common Fruit Beetle, by R. W. Jack, F.E.S.
12/24.	No. 522	Notes on the Black Citrus Aphis, by C. B. Symes.
8/25.	No. 548.	Insect Pests of Cotton, by C. B. Symes.
9/27.	No. 653.	The Care of Tobacco Seed Beds, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad).
1/28.	No. 665.	Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.
2/28.	No. 671.	Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.
6/28.	No. 696.	Ticks Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.
11/28.	No. 714.	Trap Cropping against Maize Pests, by Rupert W. Jack, F.E.S., Chief Entomologist.
12/28.	No. 718.	Preliminary Experiments on the Control of White Mould of Tobacco, by J. C. F. Hopkins, B.S. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
3/29.	No. 732.	Two Common Diseases of Potato Tubers in Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.
6/29	No. 742.	What is Diplodia in Maize? An Answer to a Popular Question To-day, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
8/29.	No. 748.	Frog Eye Disease of Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
9/29.	No. 753.	Leaf Spotting of Tobacco caused by Mosaic, by J. C. F. Hopkins, B.Sc (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
9/29.	No. 754.	"Pinking" of Maize: Report of a Preliminary Investigation, by T. K. Sansom, B.Sc., Plant Breeder.
6/30.	No. 784.	Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.
6/30.	No. 788.	A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.
		A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist. Supplement No. 1.
7/30.	No. 790.	Notes on the Control of Some of the More Important Insect Pests of Citrus in Southern Rhodesia, by W. J. Hall, Ph.D., B.Sc., Entomologist to the British South Africa Company in Southern Rhodesia.
10/30.	No. 796.	The Army Worm (Laphygma exempta, Wlk.), by Rupert W. Jack, Chief Entomologist.
11/30.	No. 798.	The Preparation of Bordeaux Mixture and Seasonal Notes on Tobacco Diseases, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.
1/31.	No. 804.	Locusts in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.
8/31.	No. 825.	Some Common Diseases of Potatoes in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), Plant Pathologist.
3/32.	No. 848.	Mycological Notes: Seasonal Notes on Tobacco Diseases: 3, Frog Eye; 4, White Mould; by J. C. F. Hopkins, B.Sc. (Lond.).

4/32. No. 850. Pests of Stored Tobacco in Southern Rhodesia, by M. C. Mossop, M.Sc., Entomologist.

6/32. No. 856. A List of Plant Diseases occurring in Southern Rhodesia, Supplement 2, by J. C. F. Hopkins, B.Sc. (Lond.), Government Plant Pathologist.

9/32. No. 861. Further Notes on Leaf Curl of Tobacco in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), Plant Pathologist.

11/32. No. 868. Cultural Methods and Tobacco Whitefly in Southern Rhodesia, by M. C. Mossop, M.Sc., Entomologist.

5/33. No. 892. The Tsetse Fly Problem in Southern Rhodesia, by R. W. Jack, Chief Entomologist.

5/33. No. 893. Experiments with Tsetse Fly Traps against Glossina Morsitans in Southern Rhodesia, by R. W. Jack, Chief Entomologist.

6/33. No. 894. Mycological Notes. Seasonal Notes on Tobacco Diseases. 6. An Unusual Type of Frog Eye Spotting, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.

6/33. No. 896. A List of Plant Diseases occuring in Southern Rhodesia. Supplement 3. (New Records for period June, 1932, to May, 1933.) Compiled by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.

7/33. No. 897. The Report of the Chief Entomologist for the year ending 31st December, 1932, by Rupert W. Jack, F.E.S., Chief Entomologist.

8/33. No. 899. The Black Maize Beetle (Heteronchus Licus Klug), by C. B. Symes.

10/33. No. 904. Notes on the Biology and Control of the Red Locust in Southern Rhodesia, 1932-1933. Part I.: Control of Locusts, by R. W. Jack, Chief Entomologist. Part II.: Biological Notes on the Red Locust (Nomadacris septemfasciata, Serv.), by M. C. Mossop, A.F.C., M.Sc., Entomologist.

10/33. No. 906. The Locust Invasion of Southern Rhodesia, 1932-33, by R. W. Jack, Chief Entomologist.

2/34. No. 911. Screw Worm. A Pest of Ranch Cattle in Southern Rhodesia, by A. Cuthbertson, Entomologist. Foreword by R. W. Jack, Chief Entomologist.

3/34. No. 913. Locusts: Instructions for dealing with Flying Swarms, by The Division of Entomology.

4/34. No. 917. The Life History of the Screw-worm Fly, by Alexander Cuthbertson, Entomologist.

10/34. No 934. Mycological Notes. Seasonal Notes on Tobacco Diseases. 7, Spraying in Seed-beds and Lands, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

12/34. No. 938. The Destruction and Control of Locust Hoppers, by R. W. Jack, Chief Entomologist.

1/35. No. 942. Mycological Notes. Seasonal Notes on Tobacco Diseases. 8, The Mosaic Mystery. 9, Danger Points in Field Spraying, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

4/35. No. 950. The Control of Tsetse Fly in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.

4/35. No 951. Suspected "Streak" Disease of Maize. Notice to Growers, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

6/35. No. 957. Annual Report of the Branch of Plant Pathology for the year ending 31st December, 1934, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

8/35. No. 962. The Report of the Chief Entomologist for Year ending 31st December, 1934, by R. W. Jack, Chief Entomologist.

10/35. No. 969. The Objects and Value of Seed Treatment of Maize against Diplodia, by G. M. Wickens, Ph.D. (Lond.), D.I.C., Assistant Plant Pathologist.

5/36. No. 986. Annual Report of the Division of Entomology for year ending 31st December, 1135, by Rupert W. Jack, Chief Entomologist.

7/36. No. 993. Annual Report of the Senior Plant Pathologist for year ending 31st December, 1935. Part I.: Plant Pathology. Part II.: Tobacco Research, by J. C. S. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist and Officer in Charge of Tobacco Research Station, Trelawney.

12/36. No. 1011. Tick Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist. Revised, November, 1936.

7/37. No. 1037. Division of Entomology: Annual Report for year 1936, by R. W. Jack, Chief Entomologist.

8/37. No. 1040. A Programme for the Control of Diseases of Apple Trees in Southern Rhodesia, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

10/37. No. 1047. Mycological Notes: Seasonal Notes on Tobacco Diseases. X.: Precautionary Methods in Seed-beds, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

12/37. No. 1050. An Unusual Winter Outbreak of Maize Weevil *Calandra oryzae*, L.), by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.

2/38. No. 1059. A Poison Bait for Young Locust Hoppers.

6/38. No. 1071. Common Diseases of Apples and their Control in Southern Rhodesia, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., and Aline L. Bacon, B.Sc., Division of Plant Pathology.

6/38. No. 1074. A Note on a Stem Rot of Sweet Peas, by J. C. F. Hopkins, D.Sc., A.I.C.T.A., Senior Plant Pathologist.

7/38. No. 1078. Mycological Notes: Seasonal Notes on Tobacco Diseases. II. Two Destructive Curing Moulds, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

8/38. No. 1079. Annual Report of the Branch of Plant Pathology for the year ending 31st December, 1937, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

8/38. No. 1080. Annual Report of the Division of Entomology for the year ended 31st December, 1937, by Rupert W. Jack, Chief Entomologist.

9/38. No. 1082. The Life History of Root Gallworm or Root Knot Eelworm, by M. C. Mossop, M.Sc., Entomologist.

10/38. No. 1086. The Spraying of Tobacco Seed-beds and Control of Rosette Disease, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist, and M. C. Mossop, M.Sc., Entomologist.

POULTRY.

1/29.	No.	721.	Poultry Keeping in Rhodesia: Pedigree Breeding, by H. G. Wheeldon, Assistant Poultry Expert.
4/29.	No.	738.	Hints to Breeders: Rearing Young Stock, by A. Little, Poultry Expert.
6/29.	No.	740.	Artificial Incubation, Breeding and Rearing of Chicks, by H. G. Wheeldon, Poultry Expert.
11/29.	No	761.	Housing and Feeding of Adult Stock, by H. G. Wheeldon, Poultry Expert.
10/30.	No.	795.	The Turkey, by G. H. Cooper, Assistant Poultry Officer
1/31.	No.	803.	Geese, by G. H. Cooper, Assistant Poultry Officer.
9/31.	No.	827.	The Ideal Brooder, by F. Roberts, Assistant Poultry Officer.
10/32.	No.	865.	Poultry Industry: Care of Young Stock in Hot Weather, by H. G. Wheeldon, Chief Poultry Officer.
11/32.	No.	870.	Trap Nests, by B. G. Gundry, A.I.MechE. (combined with No. 875).
12/32.	No.	872.	The Rearing and Fattening of Table Poultry, by H. G. Wheeldon, Chief Poultry Officer.
3/33.	No.	884.	The Vitamins in Poultry Feeding, by G. H. Cooper, Poultry Officer, Matopo School of Agriculture and Experiment Station.
5/34.	No	918.	The Moulting of Poultry: The Normal and Pullet Moult, by H. G. Wheeldon, Poultry Officer.
10/34.	No	933.	Ducks on the Farm (Revised), by H. G. Wheeldon, Poultry Officer.
12/34.	No.	939.	The Use of Galvanised Iron in the Making of Some Appliances for Poultry Keeping, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.
12/34.	No.	940.	A Cheap Portable Colony House for Poultry, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.
3/34.	No.	947.	Modern Culling of Laying Hens, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.
9/35.	No.	966.	Egg Marketing Bill: Draft of a Bill having for its purpose the more orderly Marketing of Eggs.
11/35.	No.	971.	Feeds for Poultry and How to Use Them, by G. H. Cooper, Assistant Poultry Officer.

The following pamphlets can be obtained from the Poultry Officer upon application:—

- Selecting Birds for Laying Tests, by A. Little, Poultry Expert.
- Tuberculosis, by A. Little, Poultry Expert.
- Prevention of Disease among Poultry, by A. Little, Poultry Expert.
- Preparing Birds for Show, by A. Little, Poultry Expert.
- The Fowl Tick (Argas persicus), by A. Little, Poultry Expert.
- Culling: A Seasonal Operation, by A. Little, Poultry Expert.
- Choosing a Male Bird, by A. Little, Poultry Expert.
- The Breeding Stock, by A. Little, Poultry Expert.
- Diseases of the Digestive System, by A. Little, Poultry Expert.
- Mating for Improvement and Increased Egg Production, by A. Little, Poultry Expert.
- Partial Moult: Broodiness. Selection of Layers of Large Eggs, by A. Little, Poultry Expert.

Exhibiting Eggs at Shows, by A. Little, Poultry Expert.
Condition of Birds on Show, by A. Little, Poultry Expert.
Green Food: The Result of not Supplying Sufficient to Poultry, by A. Little, Poultry Expert.
Good and Bad Hatching Eggs, by A. Little, Poultry Expert.
Grading Fowls, by A. Little, Poultry Expert.
Housing: Three Important Essentials, by A. Little, Poultry Expert.
Advice to Prospective Poultry Farmers, by A. Little, Poultry Expert
Seasonal Hints—August, by A. Little, Poultry Expert.
Successful Chick Rearing, by H. G. Wheeldon, Assistant Poultry Expert.
Hints to Breeders, October, by A. Little, Poultry Expert.
Abnormalities in Eggs, by A. Little, Poultry Expert.
Hints to Breeders. Prepare for the Breeding Season, by A. Little.
Respiratory Diseases, by A. Little, Poultry Expert.
Selection and Preparation of Fowls for Exhibition, by H. G. Wheeldon, Poultry Expert.
The Close of the Hatching Season and After, by H. G. Wheeldon, Poultry Expert.

7/38. No. 1075. The Artificial Incubation, Brooding and Rearing of Chickens, by H. G. Wheeldon, Poultry Officer.

METEOROLOGICAL.

12/22. No. 436. The Possibility of Seasonal Forecasting and Prospects for Rainfall Season, 1922-23, by C. L. Robertson, B.Sc., A.M.I.C.E.

12/24. No. 524. The Use of an Aneroid Barometer, by C. L. Robertson, B.Sc., A.M.I.C.E.

2/25. No. 532. The Short Period Forecast and Daily Weather Report, by C. L. Robertson, B.Sc., A.M.I.C.E.

6/25. No 542. Review of the Abnormal Rainfall Season, 1924-25, by C. L. Robertson, B.Sc., A.M.I.C.E.

10/28. No. 712. The Time, and How to Find It, by N. P. Sellick, M.C., B.Sc. (Eng.).

10/31. No. 832. The Weather Map and the Short Period Weather Forecast, issued by the Meteorological Office.

2/33. No. 877. Clouds and Weather in Southern Rhodesia, by N. P. Sellick, M.C., B.Sc., Meteorologist.

3/35. No. 948. The Weather, contributed by The Meteorological Office.

AGRICULTURAL BUILDINGS.

9/25. No. 554. Pisé-de-Terre, by P. B. Aird.

4/26. No. 588. Concrete on the Farm, by N. P. Sellick, M.C., B.Sc. (Eng.), Assistant Irrigation Engineer.

8/26. No. 605. Flue-curing Tobacco Barns. Bulking and Grading Sheds, by P. H. Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.

5/27. No. 644. Tobacco Baling Boxes, by B. G. Gundry, Irrigation Branch.

11/27. No. 661. Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16ft., by B. G. Gundry.

10/32. No. 863. Piggeries, by B. G. Gundry, A.I.Mech.E.

5/33. No. 889. The Construction of Dipping Tanks, by B. G. Gundry, A.I.Mech.E.; and Notes on their Management, by J. M. Sinclair, M.R.C.V.S., Chief Veterinary Surgeon.

9/33. No. 902. Brick-making on the Farm, by A. C. Jennings, Assoc.M.Inst.C.E.

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9/38.	No. 1081.	Uncontrolled Grass and Forest Fires and their Prevention, by the Rev. Father A. B. Burbridge, S.J.

THE RHODESIA
Agricultural Journal

Edited by the Director of Agriculture.
(Assisted by the Staff of the Agricultural Department).

PUBLISHED MONTHLY.

Subscription: 5/- per annum; payable to the Accountant, Department of Agriculture, Salisbury.

Vol. XXXV.] December, 1938. [No. 12.

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, *Salisbury.*

Hearty Christmas Greetings

and

Best Wishes

for

A Happy and Prosperous New Year

Pneumatic-Tyred Farm Vehicles.—The use of pneumatic-tyred roller-bearing wheels on farm vehicles is becoming increasingly common. Often parts of broken-up motor cars are used and occasionally the axle, bearings and wheels are retained, but with the pneumatic tyres replaced by iron bands bolted to the rims.

Some interest attaches to the results of tests carried out at the University of Reading farm. Loads of 17½ cwt. of basic slag in two-wheeled carts were carefully balanced and the tractive effect on movement registered by means of a dynamometer. The loaded carts were drawn over a grass field in wet winter condition and an unploughed field from which mangolds had been carted.

The dynamometer recordings over grass were 150 lb. with pneumatic tyres and roller bearings, 175 lb. with pneumatic tyres but without roller bearings and 275 lb. with ordinary wheels and iron tyres. Over soft ground the recordings were 350 lb., 350 lb., and 475 lb. respectively.

The effective horse-power required on grass at an assumed speed of 1½ miles per hour was calculated as 0.6 with pneumatic tyres and roller bearings, 0.7 with pneumatic tyres but no roller bearings, and 1.1 with ordinary iron-shod wheels. Over soft ground the figures were 1.4, 1.4 and 1.9 respectively.

The authors conclude that the power required to pull a pneumatic-tyred cart is only about two-thirds that required to pull an ordinary cart with iron-shod wheels, and further that the difference is accounted for by the tyres and not by the roller bearings. It would appear, then, that no advantage is realised if roller-bearing wheels are shod with iron tyres. The authors remark that "whereas the pneumatic tyres left very little impression on the soil and might be said to lie on the surface over a breadth of 6 in., the iron tyres sank in 1½ in. on the grass and left a very marked rut. This difference was more noticeable still on the fallow."

A Suggested New Feature.—Many of our farmers, or members of their family, are particularly interested in the

trees, shrubs or flowers which grow on their farms. Some are noticed on account of their beauty; others because they are troublesome weeds, or are suspected of poisoning stock. It has been suggested that a description of some of our common trees and plants published in the *Journal* would be of general interest. The collection of suitable material should not be a difficult matter, but the selection of subjects which are likely to be of the greatest interest to most farmers is not so easy. There are roughly 2,000 named plants known from Southern Rhodesia, including about 350 different grasses, 150 sedges, 50 orchids, 300 trees and large shrubs, 120 ferns, etc. It is obviously impossible to deal with all these in the *Journal*, as the majority would be of strictly scientific interest only. It is suggested, therefore, that the farmers should send in specimens from which a selection would be made. For trees and large shrubs a twig with leaves, flowers if possible, or fruits should be sent. For small plants such as grasses, orchids, ferns, lilies, etc., the whole plant, including the roots, should be sent if possible. Fresh, living material suitable for photographing would be most useful, but where it is impossible to send fresh plants the specimens should be pressed for a day or two between sheets of newspaper and sent packed flat between cardboard. An elaborate press is not required for drying botanical specimens. A number of sheets of folded newspaper between two boards and a strap or a heavy stone to give the necessary pressure is all that is required. A slip of paper should be put with each specimen giving the place where it was collected, the date, and the name of the collector.

Specimens should be sent to the Director of Agriculture, Salisbury. If sufficient interest is shown in this proposal it is hoped to introduce this feature from the beginning of 1939 and to continue it as a regular series in each number of the *Journal*.

Fencing of Farms.—The attention of all concerned is directed to the provisions of Section 31 of the Land Survey Act, which prohibits the practice of placing fence posts within four feet of any beacon of a property.

Advice as to how the difficulty of fencing to such beacons may be overcome is obtainable from the Under Secretary, Department of Lands, or the Surveyor-General.

The relative section of the Act reads as follows:—

> "Except with the consent of the Surveyor-General, it shall not be lawful for any person to place any fence post or fence anchor or any other erection, or to make any excavation, within four feet of any beacon or station, except in the case of stands or plots in a township, village or settlement, or plots of an area not exceeding five morgen."

Tobacco Removal Licences.—Applications for tobacco removal licences under the Tobacco Pest Suppression Act, 1933, have now been received from the majority of growers. The licences, which will be valid for the calendar year 1939, will be despatched towards the end of December. These licences must not be confused with registration as growers under the Tobacco Marketing Act, 1936, as amended.

Plantation Crops.—The chief producing countries exported 32 per cent. more rubber in 1937 than in the previous year, and world shipments of tea, sugar and tobacco increased by between 6 and 7 per cent. On the other hand, exports of both coffee and cocoa showed a decline of 9 per cent.

These facts are derived from the latest edition of the Imperial Economic Committee's review, "Plantation Crops," which has just been published by H.M. Stationery Office (price: 2s. 6d. net, 2s. 9d. post free). The most significant data and statistics on sugar, tea, coffee, cocoa, spices, tobacco and rubber are conveniently set out in this review, under headings which cover area cultivated, production, exports, imports, consumption, stocks and prices.

Consumption.—Some interesting information about consumption is given in a number of tables included in the review for the first time. The annual consumption of sugar in the United Kingdom, Australia and the United States has now

reached about one hundredweight per head of the population. Consumption per head in France and Germany is only about half as much, and in Poland, which exports sugar, is less than a quarter of a hundredweight.

Tea drinking is shown to be an Empire habit. The United Kingdom consumes each year over 9 lb. per head of the population. French Morocco and the Netherlands, which are the largest foreign consumers, use less than 3 lb. per head, and the United States takes less than three-quarters of a pound per head. On the other hand, the annual consumption of coffee in the United Kingdom is less than three-quarters of a pound per head, whereas in France it is about 10 lb. per head, in the United States over 13 lb., and in Sweden and Denmark about 16 lb.

The United States is far the chief consumer of cocoa beans, taking nearly three times as large a quantity as the United Kingdom, which is next in importance. The rubber consumption of the United States is roughly five times that of the United Kingdom. There has been a notable rise in the German absorption of rubber in recent years.

Weedy Lands Breed Pests.—Weeds in all lands should be destroyed before insect pests can mature on them. Many weed-infesting insects become crop pests. Don't let them feed and don't let them breed. In the growing season clean lands assist in the control of pigweed caterpillar, maize caterpillar, rootworm, pink grub, cutworm, army worm, stainers, and, directly or indirectly, many others.

CLEANLINESS AIDS INSECT CONTROL.

A CHRISTMAS MESSAGE.

Reap not part but reap the whole.
Cleanliness Aids Insect Control.

Feeding and Drinking Appliances for Poultry.

By G. H. Cooper, Assistant Poultry Officer.

In very few poultry keepers' yards is there to be found a good selection of appliances, and it is in the hope that some improvement may be made in this respect that these few notes on the construction of some simple appliances are given.

Material.—Timber of any sort has been found to be most unsuitable for poultry appliances in this country, because of the havoc caused by white ants and the fact that in the dry atmosphere all wood shrinks and nails drop out in time.

Galvanised iron should be used wherever possible, for it is not subject to these disadvantages and it is actually cheaper per square foot than most timber; further, it is hygienic and is more or less everlasting. It makes a neater job. The following appliances were made and tested out at the Matopo School of Agriculture and the Government Poultry Station and have given every satisfaction.

Feeder for Mature Birds (Figs. 1 and 3).—Many poultry keepers are changing their ideas about the usefulness of a large hopper-feeder, because these so-called self-feeding hoppers rarely do self-feed in practice, and further, it is preferable to place before the birds daily a fresh lot of mash. In self-feeding hoppers the birds tend to pick out certain feeds from the mash and leave the rest, which may remain before them some considerable time. The amount consumed can be better regulated in a feeder without a hopper and rats and wastage are less troublesome. The feeder described here is for half grown pullets or mature birds on range and will serve for 50 birds. If it is to be used in a laying house the top protection of iron is not necessary, the legs ending level with the alighting board. If there are more than 50 birds in a laying house extra feeders can be put in according to the number of birds. These feeders are portable. If cocks with large combs have to use this type of feeder it will be necessary to raise the roller above the trough an inch more in order not to damage the comb.

Construction.—Four troughs without ends can be made from a sheet of flat galvanised iron 6 ft. x 3 ft. A strip of iron 18 inches x 3 feet is cut from a sheet of iron, being careful to cut at right angles. Each edge along the three foot sides is bent over $\frac{1}{4}$ inch or less to make a round edge. Three inches from each edge so rounded the iron is bent at right angles lengthways. Again six inches from each of the right angles bends the iron is again bent at right angles lengthwise. This gives a V-shaped trough 3 feet long 6 inches deep with 3 inches lips bent inwards.

The ends are cut corresponding to the shape of the end of the trough bent and rivetted on. Wooden ends may be used but are not recommended.

Before fastening in the ends pieces of firm hoop iron 3 inches long, one with an $\frac{1}{8}$ inch hole near the top and one with a slot leading to an $\frac{1}{8}$ inch hole, are rivetted one to each end in the middle and allowed to project over the top end, so that the holes are $1\frac{1}{2}$ inches from the top of the end.

A piece of wood 1 inch x 1 inch x 3 feet is taken, a $2\frac{1}{2}$ inch nail cut in half and each half hammered into an end of the wood in the centre, leaving $\frac{1}{2}$ inch projecting. This forms the roller and is placed in position by pushing the nail without head through the hole in the hoop iron at one end of the trough and the other into the hole at the other end by means of the slot. This roller will now revolve on being touched and so serve the purpose of keeping the birds from getting into the feeder or from perching on the roller and soiling the feed. A piece of plain wire No. 8 fastened along the top in the position of the roller has also been found satisfactory. This completes the trough section (fig. 3) which is placed in a stand as shown in the photograph (fig. 1).

The stand can be conveniently made from timber to be had from a motor car case or flooring board.

Take four pieces of timber each 2 inch x 2 inch x 2 feet 9 inch to form the legs, or four pieces of angle iron 2 feet 9 inch long; these are held apart lengthwise by cross pieces 3 feet x 3 inch x $\frac{7}{8}$ inch nailed or bolted at right angles, the top of cross pieces being 18 inches from ground level.

Two pieces of timber 16 inch x 6 inch x $\frac{7}{8}$ inch are nailed or bolted to the inside of the leg pieces at the same height as the cross pieces. These serve to keep the legs apart across the structure and to hold the trough. Before fixing these last planks in position a right angle notch is sawn out of the middle of each, the point of the V being half way, or 3 inches down, the plank.

Two pieces of timber, 3 feet x 3 inch x $\frac{7}{8}$ inch are next nailed to the last mentioned pieces, one on each side, between the legs to serve as alighting boards for the birds to stand upon when feeding. Again two pieces 16 inches x 6 inch x $\frac{7}{8}$ inch are taken and sawn to form a sloping top, being 3 inches at the ends and 6 inches in the centre. One piece is nailed to the projecting legs above the trough at each end. Over these is bent and attached with screws a piece of corrugated or flat iron 3 feet x 2 feet. Feeders may be made 6 feet long by cutting the sheets of iron in half lengthwise. If this is done a wooden support is advisable half way inside the trough and, of course, the stand must be made the appropriate length. The feeder is now complete and may be used for mash or grain feeding.

When these feeders without tops are used in a laying house it is advisable to have a storage bin containing feed, either in the house or in close proximity. A rat-proof bin made from a 44 gallon drum is ideal. A sloping lid of galvanised iron to prevent birds perching can be constructed and the drum placed in the house.

Feed Troughs for Chickens (Fig. 4).—For baby chickens until about three weeks of age. A piece of flat galvanised iron is cut 3 feet x 7 inches wide. Each 3 feet edge is bent over $\frac{1}{4}$ inch to form a smooth edge. Again each 3 feet edge is bent at right angles $\frac{1}{4}$ inch from the edge. One and one-half inches from each of these right angle bends the iron is again bent at right angles. This gives a 3 feet rectangular trough 3 inches wide, $1\frac{1}{2}$ inches deep, with a $\frac{1}{4}$ inch lip turned inwards along each side.

Two ends of galvanised iron about $3\frac{1}{2}$ inch x 2 inch are cut, bent to fit and rivetted into each end. A piece of plain galvanised wire No. 10 is taken 3 feet 1 inch in length and

$\frac{1}{2}$ inch turned at right angles at each end. This wire is placed down the centre of the trough and the bent over ends soldered to the ends of the trough. Five pieces of similar wire 5 inches in length are taken and in the centre are looped around the wire running lengthwise down the trough. The five short wires are now soldered on each side of the trough at regular intervals of 6 inches. These are at right angles to the long wire and keep it firmly in place along the centre of the trough. The wires prevent chickens from getting into the trough and scratching out the mash. For chickens from three weeks to three months of age similar troughs can be made of slightly larger dimensions having an opening each side of the centre wire of not more than 2 inches. The trough portion of the feeder for mature birds described previously can be placed upon the ground and securely propped up with bricks on each side for use by chickens just before they are able to get up to the alighting board on the stand. These comprise all the feeding utensils that will be required on the poultry farm.

Drinking Vessels (Fig. 5).—For baby chickens until about two weeks of age. The old reversed bottle type of drinking fountain is hard to beat if the stand is made of galvanised iron and the bottle used is of a clear glass so that it can easily be seen if it is clean.

For the bottle use a square sided Johnnie Walker whisky bottle. These are always of clear glass and the same size, as well as being easily procurable.

To make the stand and drinking trough all in one is essential.

Take a piece of flat galvanised iron 1 foot x $4\frac{3}{8}$ inch. Turn the two edges along the long sides over $\frac{1}{4}$ inch as before to make a smooth edge. Again bend each edge at right angles $\frac{1}{2}$ inch from the edge. This is to form the upright support for the bottle. Cut another piece of iron 5 inch x 3 inch to form the bottom of the drinking trough and round off two of the points at one end.

Take a piece of iron 12 inches long and $1\frac{1}{2}$ inches deep, bend over one edge $\frac{1}{4}$ inch and flatten. Bend this piece of iron round the piece of 5 inch x 3 inch to form a receptacle, having the turned edge upwards. These are then held securely and soldered together.

The upright support with the ½ inch flanges inwards is then soldered at one end to the three-sided receptacle thus formed, making a water-tight receptacle with the upright support at one end.

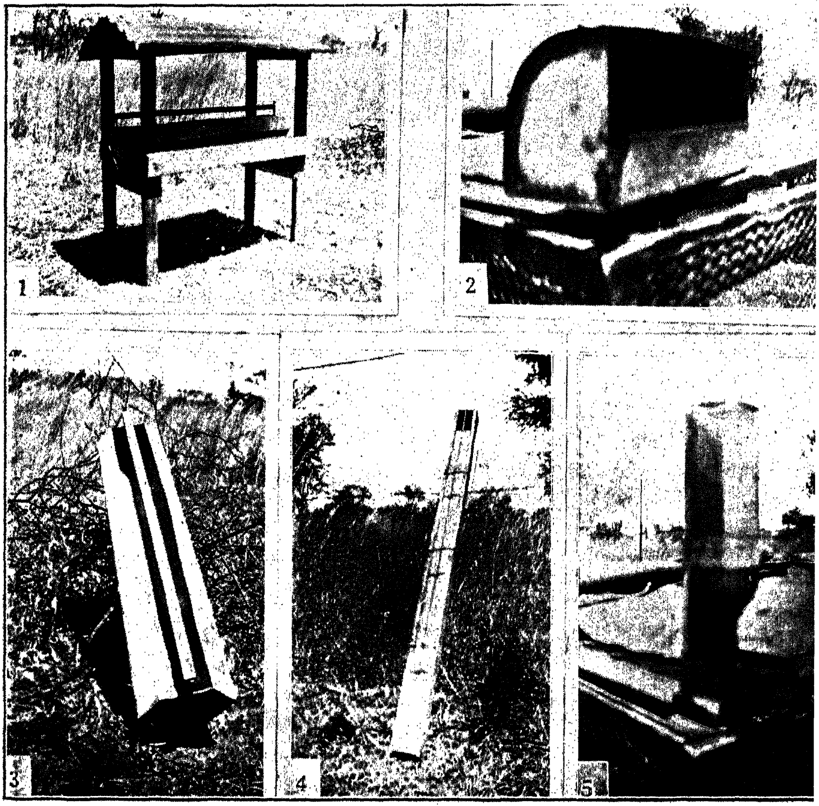
A piece of iron 8 inch x 1½ inch is soldered in a loop to the upright support on the inside of the ½ inch flanges half way up and bent to take the shape of the bottle. This is the support for the bottle to prevent it from falling out. The bottle is placed in position by pushing it mouth first down the upright support through the loop of iron so that the orifice is just below the top edge of the receptacle. Measure the distance between the orifice of the bottle and the bottom of the water receptacle—it will be about 1 inch. Immediately below the orifice of the bottle solder a piece of iron ¼ inch wide bent like an arch with feet. This strip of iron prevents the bottle from slipping too far into the receptacle. The bottle is filled with water and quickly placed in position as described previously. The water will pour out into the receptacle until the level of the orifice is reached when it will be checked. As the water is consumed the level will drop and water will flow from the bottle. This receptacle is always full so long as there is water in the bottle.

It is important that the orifice of the bottle should be just below the rim of the container and that the vessel should be level, otherwise the water will flow continually.

The fountain may be used for milk also if it is not too thick.

Drinking Vessel for Larger Chickens (Fig. 2).—Cut a piece of galvanised iron 16 inch x 12 inch. Bend over each edge along the 12 inch sides ¼ inch to make a smooth edge.

Two inches from one of these edges bend the iron at right angles. Again five inches from the last bend make another right angle bend. With the 5 inch side downwards on the bench bend the longer upright side over in a curve till the edge is immediately above the edge of the shorter upright side, and 3 inches from it. Two ends 5 inches wide and cut to fit the curve are rivetted and soldered in and the vessel is complete. The water or milk is protected from contamination by birds and from heating by the sun.



(1) Outdoor Feeder for Mature Birds.
(2) Drinking Vessel for Larger Chickens.
(3) The Metal Trough. Section of Feeder.
(4) Metal Feed Trough for Chickens.
(5) Drinking Fountain for Baby Chickens.

Larger vessels may be made for mature birds on a similar pattern having a deeper water receptacle up to six inches. If these appliances are made as suggested and well cared for they will be nearly everlasting as well as being economical and hygienic.

These appliances are easily constructed, and if the poultry farmer will study the requirements of his flock he will probably be able to improve on them himself. They may be seen in use at the Government Poultry Station, Salisbury.

A Further Note giving

a more detailed explanation of the Administration of:

NODULAR WORM REMEDY.
NICOTINE AND BLUESTONE REMEDY.
TETRACHLORETHYLENE EMULSION.
CARBONTETRACHLORIDE.

By PERCY D. HUSTON, M.R.C.V.S., District Veterinary Officer.

Table of efficacy of various treatments:—

Government Wireworm Remedy effective against	Wireworm.
Nicotine and Blue Stone Remedy effective against	Bankrot worm. Wireworm. Tapeworm.
Nodular Worm Remedy effective against	Nodular worm. Wireworm. Tapeworm.
Tetrachlorethylene Emulsion effective against	Hook worm. Wire worm slight. Bankrot worm slight.
Carbontetrachloride effective against	Fluke. Hook worm slight.

THE NODULAR WORM REMEDY.

Supplied by the Director of Veterinary Research, Salisbury.

Method of Treatment.—The sheep must not be kept from food or water before or after treatment. They should be taken to water immediately before treatment, but must not be driven a long distance.

No maize or other grain and no salt lick should be given from two days before until a day after treatment. If the pasture is dry it is very desirable to run the sheep on green feed for a few hours before each dosing, and to give water.

Sucking lambs must not have milk for four hours before and two hours after treatment.

The sheep must be dosed on a full stomach. The best time is in the late afternoon.

If the pasture is dry, feed is scarce, and the sheep are weak, dosing may be dangerous.

The sheep must be treated as quietly as possible, otherwise adverse effects may follow, especially in the case of sheep in good condition. Use a crush for dosing.

The efficacy of the remedy depends on its being swallowed directly into the fourth stomach, and this is brought about by administering a small quantity of bluestone solution immediately before the remedy. The moment the latter reaches the throat of the sheep the large stomach closes and remains closed for at least 15 seconds.

The treatment therefore consists of the following two parts:—

(1) The spoon marked X is taken in the left hand and filled with a 10 per cent. bluestone solution (to prepare this, dissolve 1 lb. of bluestone in 1 gallon of water, or 2 oz. to 1 pint water, or $2\frac{2}{3}$ oz. to 1 bottle water). Open the sheep's mouth well and pour the bluestone along the side of the tongue so that it runs down into the throat. For small lambs a three-quarter spoonful is sufficient.

(2) The correct measuring spoon is filled with the remedy beforehand and is kept ready in the right hand to be emptied on to the back of the tongue immediately after giving the bluestone, without waiting until the sheep has swallowed the bluestone solution. Directly after administration of the powder the mouth is closed and the sheep released.

Measuring the Dose.—Before using the remedy it is desirable to empty the contents of each tin into a suitable receptacle, and to stir it well. A quantity of the powder is

then placed in the tin with the cross-beam (as used with Government wireworm remedy). The correct measuring spoon is filled lightly, without pressing against the side of the tin, and scraped off level against the underside of the cross-beam.

The remedy is administered by means of the measuring spoon. Should the spoon become wet and the powder cling to it, it must be wiped. The following are the correct doses:—

For lambs 3 to 6 months of age, spoon No. 1.

For lambs over 6 to 18 months of age, spoon No. 2.

For sheep over 18 months of age, spoon No. 3.

It has been found that the remedy is also effective against tapeworm. For lambs under 3 months old the bluestone solution is made half as strong as for older sheep and they get the following doses of the powder:—

3 to 7 weeks old, one No. 4 wireworm remedy spoonful.

8 to 12 weeks old, two No. 4 wireworm remedy spoonfuls.

Calves get one No. 3 nodular worm remedy spoonful, after bluestone, and the dose is repeated next day in the case of calves weighing 100 lb. or more.

Results of Treatment.—The young nodular worms live in the nodules in the gut wall for one week or longer, up to three months. Then they go to live inside the large intestine, where they grow adult. The remedy does not kill young worms in the nodules, nor does it remove the nodules, but it kills the worms in the large intestine. The remedy also kills wireworm.

When and how often to Treat.—Experience has shown that repeated treatments are necessary to clean a flock. It is therefore now recommended to give single doses regularly every three weeks as long as the pasture is green, and this will be effective against both wireworm and nodular worm.

In winter, when the pasture becomes dry, the sheep cease to become infested, but they may still carry many young worms in nodules and will therefore not be clean even if they

are dosed until the pasture is dry. For the next three months new worms may develop in the sheep out of the nodules. If sheep have been run on badly infested pasture, it may be necessary to dose them once or twice during the winter.

In any case, it is of the greatest importance to start regular dosing as soon as there is some green grass in spring, in order to clean the sheep of worms which they have carried through the winter, and thus to prevent them from again infecting their pasture when the rainy season begins.

A double dose of the remedy may also be given if sheep are not too weak, *i.e.*, the treatment is carried out twice on two successive days. Where nodular worm is a serious pest, it may be advisable to begin and end the season's dosing with double doses.

Special Measures.—*Ewes.*—It is not advisable to treat ewes from about a month before lambing up to about a fortnight thereafter. Pregnant ewes must be handled carefully.

Warning.—Since the remedy is poisonous, it should be handled carefully, and sheep should not get more than the doses recommended.

Lasting Properties of the Powder.—The powder does not deteriorate or lose strength, but it is advisable to keep the tins well closed and to store them in a dry place.

NICOTINE AND BLUESTONE REMEDY.

This remedy is the most suitable general purpose dose for this Colony, owing to its efficiency in killing two of the most common parasites, namely, Bankrot worm and Wireworm. When used to combat Bankrot worm infection or as a general purpose dose it should be given every three weeks throughout the year. When this remedy is used to eradicate tapeworm it is necessary to starve the sheep for twenty-four hours prior to dosing. One administration should be sufficient to remove all tapeworms.

Mixture.—

One ounce (liquid) Tobacco Extract containing 40% Nicotine.

One ounce (avoirdupois) Copper Sulphate (Bluestone).

Three pints of water. Preferably rain water.

Dissolve the *one ounce* of bluestone in the *three* pints of water, then add the *one ounce* of nicotine extract. Keep mixture well shaken to ensure uniform strength of mixture. Only use copper, enamel, glass or earthenware containers.

Tobacco extract 40% nicotine content can be obtained from any chemist, and is manufactured by Macdougall, Ltd., distributed by Cooper & Nephews, Ltd.; a two pound tin is sufficient for 1,500 to 1,700 doses and costs about 16s. 6d. Nicotine is volatile and so to preserve its strength, after opening tin, transfer it into bottles, which should be securely corked.

Doses:—

Lambs 1 to 4 months old, ½ liquid ounce of mixture.

Lambs 4 to 6 months old, ¾ liquid ounce of mixture.

Lambs 6 to 12 months old, 1 liquid ounce of mixture.

Sheep over 12 months old, 1½ to 2 liquid ounces of mixture.

Sheep in very poor condition should be given a slightly smaller dose than indicated above; but they should be dosed every 14 days. Ewes and lambs should not be dosed during the four weeks before lambing.

Method of Administration.—It is not necessary to keep the sheep away from food and water before dosing—after dosing they should be kept from water for four hours. When dosing suckling lambs, remove them from their mothers four hours before dosing, and they should be kept away for four hours after dosing.

Bottle should be used for administering. One and two ounce sizes will be found the most useful. Measure or judge very carefully the quantity of mixture required. Keep the animal on all four legs, hold the animal's head well up with mouth open, taking care that the tongue is free, pour the mixture well back in the mouth. Do not chase the animals about unduly. Excellent dosing guns are now on the market by the use of which dosing is made much less arduous.

TETRACHLORETHYLENE EMULSION ("TETRAM.")

An emulsion of tetrachlorethylene which is mainly intended as a remedy against hookworms in sheep, but may also be used against other parasites as described, is procurable from the Director of Veterinary Research, Salisbury.

For Sheep and Goats.—The remedy kills hookworm, wireworm and bankrot worm, and probably also the brown stomach worm.

The sheep must not be kept from food or water before or after treatment. Lambs should get no milk from four hours before until two hours after treatment. The animals must be treated when it is cool and must be kept out of the sun for a while after treatment. The best time to treat is late in the afternoon when it is cool. Before, during and after treatment, the sheep must not be chased about.

As in the case of the nodular worm remedy, each sheep must first get $2\frac{1}{2}$ c.c. of a 10% bluestone solution, immediately after which the remedy must be given. The spoon (marked X) of nodular worm remedy can be used to administer the bluestone solution. (To make 10 per cent. bluestone solution, dissolve 1 lb. bluestone in 1 gallon of water, or 2 ozs. bluestone in 1 pint of water.)

The emulsion is used as follows:—

Shake the tin well. Open it and pour into a suitable bowl, say, three cupfuls of the emulsion and close the tin. Add to the bowl 3 cupfuls of soft water (equal quantities of emulsion and water). Stir occasionally and administer this mixture, immediately after the bluestone solution, by means of a suitable syringe:—

to lambs of 3 to 6 months old, 10 c.c.

to lambs of over 6 to 12 months old, 15 c.c.

to sheep over 12 months old, 20 c.c.

The remedy must be administered slowly into the side of the mouth.

Mix small quantities of the remedy at a time and keep the bowl and the remedy clean.

The treatment has to be repeated twice with intervals of 10 to 14 days in order to clean the sheep of hookworms. If the sheep continue to run on infested ground, more treatments will be required.

In order to exterminate hookworms, it is best to clean the sheep during the dry season.

Pregnant ewes should not be treated for about a month before lambing.

First make a test on a small number of sheep in order to see if there are no local conditions which might cause adverse effects.

Dosing Syringe.—The Director of Veterinary Research, Salisbury, sells a suitable syringe for the administration of this remedy. The syringe holds up to 60 c.c.

CARBON TETRACHLORIDE.

Method of Treating Sheep for Fluke with Carbon Tetrachloride.—This drug can be given with liquid paraffin or skimmed milk; linseed oil may also be used. The strength of the mixture is one in four.

Sheep should be grazed on grass veld for fourteen days before dosing and the animals should be given ½ oz. bonemeal per day for that period, or failing this, have free access to a lick containing bonemeal and salt.

Lucerne and bean hay should not be given for ten days before or seven days after dosing.

Very fat or very thin sheep should not be dosed. Ewes heavy in lamb or with lambs at foot should also be left out.

Animals should not be dosed in very hot or cold weather, and they should be kept as quiet as possible for several hours after dosing and not driven long distances to grazing.

The mixture of one part carbon tetrachloride and four parts of liquid paraffin, or linseed oil, is made and well shaken, and the dose is 10 c.c. for adult sheep and 5 c.c. for lambs 6 to 12 months old. Animals in poor condition should only receive half a dose.

The dose is administered slowly by a syringe, with a nozzle attachment, into the corner of the mouth of the sheep.

If skimmed milk is used instead of liquid paraffin or linseed oil, the dose of carbon tetrachloride must first be drawn up into the syringe, and then the skimmed milk afterwards. The syringe should be well shaken before being administered as above; this precaution is necessary because carbon tetrachloride does not mix with the skimmed milk.

Before dosing a flock of sheep it is advisable to select three or four of the worst animals in the flock and give them the dose prescribed to see what effect the drug has, because it sometimes has a more severe effect on some flocks and breeds.

As some difficulty was experienced in understanding the previous table set out for dosing sheep, I have now drawn up a table for the year 1939, commencing in the first week in January, showing what treatment should be given each week. As before N.O. stands for nodular worm remedy; N.B. for nicotine and bluestone. A dash is inserted in each week where no treatment is given.

Where it is desirous to give a hookworm treatment, the weeks in which this can best be substituted are indicated by the letters TET—short for tetrachlorethylene emulsion. The nicotine and bluestone remedy is not given during this treatment and the N.B. is marked with a * in the weeks in which it is withheld.

Acknowledgement is made for information obtained from articles printed in *Farming in South Africa.*

January: 1st-7th N.O.	8th-14th —	15th-21st —	22nd-28th N.B.	29th-4th Feb. —
February: 5th-11th —	12th-18th N.O.	19th-25th —	26th-4th Mar. —	
March: 5th-11th N.B.	12th-18th —	19th-25th —	26th-1st April *N.B. TET	
April: 2nd-8th —	9th-15th —or TET	16th-22nd *N.B.	23rd-29th —or TET	30th-6th May —
May: 7th-13th N.O.	14th-20th —	21st-27th —	28th-3rd June N.B.	
June: 4th-10th —	11th-17th —	18th-24th N.O.	25th-1st July —	
July: 2nd-8th —	9th-15th N.B.	16th-22nd —	23rd-29th —	30th-5th Aug. *N.B. TET
August: 6th-12th —	13th-19th —or TET	20th-26th *N.B.	27th-2nd Sept. —or TET	
September: 3rd-9th —	10th-16th N.O.	17th-23rd —	24th-30th —	
October: 1st-7th N.B.	8th-14th —	15th-21st —	22nd-28th N.O.	29th-4th Nov. —
November: 5th-11th —	12th-18th N.B.	19th-25th —	26th-2nd Dec. —	
December: 3rd-9th *N.B. TET	10th-16th —	17th-23rd —or TET	24th-30th *N.B.	31st-6th Jan. TET

Feeding of Sunnhemp Hay to Dairy Cows.

Experience of Major R. R. SHARP, Redbank, Bulawayo.

During the past dry season Major R. R. Sharp, Redbank, Bulawayo, has carried out a feeding trial with sunnhemp hay for dairy cows. Major Sharp has kindly supplied this Department with the particulars of his experiment, and, as the results are likely to be of considerable interest to stock farmers, the information that he has furnished has been summarised for the *Journal*.

The experiment commenced on August 1st, 1938, and was carried out for a period of approximately two months.

There were 24 cows in the trial, 12 on each side of the byre.

From August 1st to 26th all the cows (24) received cowpea hay at the rate of 5-6 lbs. per head per day. From that time the cows on the one side of the byre (12) received cowpea hay as before, while those on the other side were changed over to the same quantity of sunnhemp hay. Both hays appeared to be of good quality, although Major Sharp states that he has made better. The cowpea hay had a little rain on it during curing, but was on tripods and was, therefore, still leafy and green. The sunnhemp was a little coarse, being sown too thinly, but in other respects it was of excellent quality.

After 3½ weeks the feeding of sunnhemp hay was discontinued and both sides were put again on to cowpea hay.

The average production of the cows is shown below. Apart from legume hay the cows received the same treatment and were fed 30 lbs. of silage, a little veld hay and 3½ lbs. of concentrates per gallon of milk produced. The concentrate

mixture used was one of nine parts maize, one part ground nut cake, one part blood meal, one part sunflower meal (by weight).

	GROUP A. Lbs. of milk per cow per day. Cowpea Hay.	GROUP B. Lbs. of milk per cow per day. Sunnhemp Hay.
August 1-26th...	24.7	18
Aug. 27th-20th Sept. ...	23.4	17.5
Sept. 21st-3rd October ...	19.6	15.2

Group B was fed sunnhemp hay from the 27th August to the 20th September inclusive. Group A was fed cowpea hay over this period.

So far as this trial goes, Major Sharp suggests that this trial shows that sunnhemp hay is, if anything, superior to cowpea hay, since Group B dropped only 2.8% in their milk production on sunnhemp hay while Group A on cowpea hay dropped 7.8% during this 3½ weeks of the trial. Both groups dropped about the same amount during the final two weeks when put back on to cowpea hay.

He says the experiment would, of course, have to be repeated, but the indications are that sunnhemp is quite a useful feed, although it is not as palatable as cowpea hay.

In regard to this trial the Chief Animal Husbandry Officer remarks that similar reports on the feeding value of sunnhemp hay have been received from other dairy farmers and the attention of those interested in the crop is also directed to Bulletin No. 1053 of this Department, which gives the results of feeding sunnhemp hay to fattening bullocks. It must further be emphasised that the crop should be cut as it comes into flower in order to make the most palatable hay and that it is advisable to chaff it before feeding to save waste. Feeders are coming more and more to appreciate the value of a legume hay for feeding during the winter months, and it is likely that a considerable area of sunnhemp will be sown for the production of hay this season. In a short time, therefore, a considerable amount of practical experience on the feeding of the crop should be available.

Tobacco Production and Consumption

IN THE UNION OF SOUTH AFRICA.

In our country the tobacco producer is protected by an import duty of 3s. 6d. per lb. From the beginning there has been a shortage in South Africa of tobacco varieties for the manufacture of cigarettes, and these varieties had therefore to be imported. This shortage of light tobacco of good quality still exists, and will probably continue for quite a number of years to come. It is self-evident, that when the import duty on tobacco is high, only that of best quality comes into consideration. On account of the protection against foreign competition, the tobacco industry is not exactly practised on a basis that will allow of development and improvement. By sound application of a tax on tobacco, the necessary encouragement could be given for the improvement of the local qualitative production, but the tobacco tax of 1922 unfortunately evoked so much unfavourable criticism that it was speedily withdrawn. Since then the Union, on account of rising import duties on tobacco, received in increasing quantities foreign tobacco of high quality only; but the local producer was allowed to produce freely, actually undisturbedly, tobacco of the poorest quality. Consequently, the Union produces a large quantity of tobacco which really should not be sold.

Tobacco production is gradually increasing in our country. The estimate for the present season amounts to 23½ million lbs. of tobacco. At the most 11 million lbs. of this yield may be expected to be of the light tobacco varieties, comprising 4¼ million lbs. of flue-cured, 6 million lbs. of air-cured, and three-quarter million lbs. of Turkish. Of the darker varieties alone, therefore, 12 million lbs. are produced. As regards future production, the possible development of new areas must be considered, especially those under irrigation, as Loskop, Vaalhartz and Lindleyspoort, as well as the change over from other industries to tobacco-growing. Many farmers regard the tobacco industry as being fairly favourable

economically, whereas several other agricultural products are produced at a considerable loss, thus sometimes forcing producers to seek a way out by cultivating tobacco. New producers at the outset usually produce dark tobacco, and it is therefore quite probable that the production of dark varieties in the country will still increase considerably during the coming years.

The latest official figures available for the census year 1935-36 indicate that 20,000,000 lbs. of tobacco were used for manufacturing purposes, 8,000,000 lbs. being used for cigarettes. No later published figures are available, but according to excise returns the manufacture of cigarettes increased to 9,600,000 lbs. of tobacco in 1937-38. The total consumption of tobacco may in these circumstances be estimated at 22½ million lbs. According to calculations, this includes: flue-cured 5,000,000 lbs.; light air-cured 6,500,000 lbs.; Turkish, 850,000 lbs., and dark tobacco, 10,150,000 lbs.

Tobacco stocks on hand at the different large manufacturers and co-operative societies on 30th June, 1938, were as follows: Turkish, 2,638.000 lbs.; flue-cured, 9,259,000 lbs. (which must be increased by duty-free imports of 2,400,000 lbs. to 11,659,000 lbs.); air-cured, 16,107,000 lbs. (which also has to be increased by some two million lbs. in the stocks of traders from whom no returns were received, besides an estimated 12 million lbs. still in possession of farmers on farms, making a total of more than 30,000,000 lbs.).

The above figures and calculations indicate that manufacturers have the following stocks on hand in excess of the requirements for the next twelve months:—

1. Flue-cured tobacco sufficient for manufacturing for 16 months.
2. Turkish tobacco sufficient for manufacturing for 25 months.
3. Air-cured tobacco sufficient for manufacturing for 23 months.

Tobacco intended for the manufacturing of cigarettes requires a maturing period of twelve months before it is suitable, while air-cured tobacco may mostly be used for

manufacturing purposes immediately. The minimum stocks for flue-cured and Turkish tobacco must therefore satisfy the requirements of an average of 18 months (or say from 12 to 24 months), while stocks of the air-cured variety, sufficient for more than an average of six months, indicate that there are ample supplies.

The present stocks in relation to the requirements of the country, therefore, appear to indicate that the position of flue-cured tobacco is favourable, but that of air-cured, and especially Turkish tobacco, very unsatisfactory. In spite of the fact that during the next twelve months no duty-free importation of Turkish tobacco will be allowed, it would be advisable for producers of Turkish tobacco to decrease production (as before) and to limit advances on tobacco taken by their co-operative societies, until the large stocks have been reduced by the manufacturers. In the case of air-cured tobacco, it is the dark tobacco that may cause trouble, and in this case too it would be advisable for farmers' organisations to increase the difference in prices of desirable and less desirable grades of tobacco. This will encourage the progressive farmer to make still greater efforts to produce as little of the dark grades as possible, as the demand for these varieties is smaller than the supply.—(J. H. du Plessis, S.A. Dept. of Agric. Press Service.)

CATTLE BALE or GRIP.

The export of chilled beef has brought the question of bruising prominently to the fore. Where cattle have to be "mouthed" before they are moved, there is a serious danger of bruising if proper equipment is not available to hold them and they are allowed to struggle.

These bruises spoil the appearance of the beef and, if serious, lead to the rejection of the carcases for export. Sometimes, however, the damage is internal and may escape the local inspector. In these cases the trouble is discovered when the quarter is cut up overseas and the beef is either returned to the agents or compensation has to be paid. Rhodesian beef in any case receives a poor advertisement.

Apart, however, from the question of bruising, a good crush with a bale or grip is essential on any cattle farm where the cattle are not stabled. It facilitates the handling of the cattle, the dressing of wounds, castration, de-horning and so on.

The Department is indebted to Mr. R. C. Simmons, of Glass Block, Balla Balla, for the plan of the grip shown in figure 1, and to Mr. H. F. Gleadow, of Central Estates, for the one shown in figure 2. Both designs have given full satisfaction on the ranches where they are used.

Both grips are good, but the one shown in fig. 2 is probably the more effective for wild cattle and cattle with long horns. It looks more open to the oncoming cattle and they face up to it better. There is the danger, too, of a long horned beast edging partly through the grip No. 1 with its head sideways, before the tip of the second horn is cleared. It is then difficult to pull the gripping bar across in time to hold the animal. Grip No. 1 is, however, simpler of construction.

Construction Figure 1.—In this design two upright posts of 4 inch iron piping "A" and "B" are set in the ground at the end of the race leading from a crush and collecting pen. These

posts are connected at top and bottom by horizontal cross pieces "D" made of 3 inch piping secured by $\frac{5}{8}$ inch bolts. The single gripping bar "C" is hinged between the lower cross pieces by another $\frac{5}{8}$ inch bolt placed so that there is 6 inches clearance between the gripping bar, when standing vertical, and the post "B." The upper end of the gripping bar is slotted to receive the ratchet bar "E" which works on a hinge bolt as shown in detail on the drawing.

The ratchet bar rests in a slot at the top of the post "B" and the ratchet teeth engage with the inner side of the pipe at the bottom of the slot and hold it in the desired position when the bale is in operation.

Although iron piping is to be recommended for these parts of the structure on account of its durability, hardwood poles might be substituted and would give good service for a limited time.

Operation.—Each animal to be examined or treated is driven along the race until its head projects beyond the gripping bar when the latter is quickly drawn towards the post "B" by means of the ratchet bar so that the animal is held firmly by the neck.

Figure 2.—In this design of bale there are two gripping bars hinged by bolts at the bottom and linked together at the top in such a manner that they close in towards the centre when the hand lever is lowered.

The construction and method of working is quite clearly shown in the drawing and little further explanation is required. It should be understood that the central bolt which connects the extension of the hand lever and the links connecting the two side gripping bars must be adjusted so that it is free to slide up and down between the vertical guide bars. A large flat washer placed on each side of the guide bars and kept greased will prevent the mechanism jamming.

The gripping bars might with advantage be made of 3 inch iron pipe which could then be hinged at top and bottom with a single bolt passing through them, or the same result could be attained by fitting the ends of the poles with ferrules

of 3 inch piping about 6 inches long. There would then be no necessity for the separate hinge plates which are shown bolted to the ends of the poles and the danger of the poles themselves splitting through the bolt holes would be removed.

General.—In both these drawings no extension of the race is shown beyond the grip. It is a good plan, however, to continue the race for a short distance and keep it closed at the end by slip rails. If an animal is missed by the grip it can be then driven back to the necessary position without having to be herded back to the collecting pen.

If the grip is not placed at the end of the race, as in the diagrams, there should be a gate in the side of the race just beyond the grip so that the operator can get at the head of the animal easily. It is also an advantage to have some of the poles behind the grip so fixed that they can be slid out and the back portions of the animal can be reached conveniently.

Cleanliness Aids Insect Control
in Lands and Sheds, Stores and Farmsteads.

Farm Butter Making.

Issued by The Dairy Branch.

Introduction.—The results of the grading of farm butter which has been carried out under the Dairy Act during the past season indicate that a very large proportion of the farm butter sold in the Colony is of very inferior quality; less than 13 per cent. of the butter examined was found to be first grade, the bulk of it being third grade and cooking butter. Furthermore, most of the defects observed were such as would be caused by faulty manufacturing methods or by lack of care and attention in the production and handling of the cream from which the butter was made.

There is no reason why farm butter should not be a high grade product provided that it is properly made and the necessary care exercised in the production and handling of the cream. Generally speaking, however, even the best farm butter is lacking in uniformity and keeping quality and for this reason cannot be regarded as a commercial or exportable article in the same sense as creamery butter. As the future development of the dairying industry depends almost entirely on the prospects of establishing an export trade it will obviously be necessary, as the Colony's production continues to expand, to restrict the manufacture of butter to the creameries which are properly equipped with cold storage facilities and other appliances necessary for the production of an article suitable for the export trade.

In recognition of this fact provision has been made in the Dairy Act for the application of certain restrictions to the manufacture of farm butter which, it is hoped, will ultimately result in the elimination of this product from the industry. Pending this development, however, which must of necessity be gradual, there is no reason why farmers who continue to make butter should not endeavour to improve the quality of their product, and it is hoped, therefore, that the information contained in this article will be of some assistance in this direction.

Before dealing with the actual butter making process, however, it might be advisable to indicate briefly the requirements of the Dairy Act in relation to the manufacture and sale of farm butter.

REQUIREMENTS OF THE DAIRY ACT IN RELATION TO MANUFACTURE AND SALE OF FARM BUTTER.

Farm Butter Licences.—Many farmers and others appear to be under the impression that the manufacture of farm butter is entirely prohibited under the Dairy Act which came into force on the 1st January of this year. This is not the case. The Act makes provision for the licensing of farm butter, but this does not come into force until the 1st January, 1939; after that date any person wishing to make farm butter—other than that required for consumption by himself and his household—will have to obtain a farm butter licence from the Dairy Industry Control Board.

The Dairy Industry Control Board is empowered under the Dairy Act to issue licences to the following persons:—

(*a*) any person who satisfies the Board that before the commencement of the Act he was engaged in and had built up a high-class business in the making and sale of farm butter. Generally speaking, a farmer would be considered to have established a high-class business if he has been a regular producer and if his butter has been of reasonably good quality and has realised a price above the average obtainable for farm butter and approximating that paid for the better grades of creamery butter.

(*b*) any person approved by the Board in a remote area in which, in the opinion of the Board, the making and sale of farm butter is desirable in the interests of the local community or any section of the community.

This provides for the issue of a licence for the making and sale of farm butter in a remote area—such as a far distant mining village or township—where it might be difficult, or at least inconvenient, for the local community to obtain butter from a creamery.

(*c*) Any person who, owing to distance from a creamery or to lack of facilities for transport is, in the opinion of the Board, unable to supply cream to a creamery.

All farm butter licences expire on the 31st December next succeeding the date of issue, but may, on application of the holder and subject to the provisions of the Dairy Act, be renewed by the Board from year to year. The Board is also empowered to attach certain conditions to the licence, *i.e.*, the Board may limit the quantity of farm butter which may be made and sold by the licensee during the currency of the licence and may also fix the wholesale and retail prices at which the butter may be sold and may further require that the butter shall only be sold within a certain fixed area. The Act also contains a provision to the effect that if any condition attached to the licence is contravened, the Board may, on proof thereof, cancel the licence. It is also provided that after a date to be fixed by the Minister of Agriculture and Lands, which shall not be earlier than five years after the commencement of the Act, the issue and renewal of farm butter licences in terms of paragraphs (*a*) and (*c*) above shall be discontinued.

Applications for farm butter licences should be addressed to the Secretary, Dairy Industry Control Board, P.O. Box 1241, Salisbury.

Butter Levy.—The Dairy Industry Control Board is empowered under the Dairy Act to impose a levy not exceeding one and a half pence per pound on all butter made in or imported into the Colony, except butter made by any person for consumption by his own household.

In the case of farm butter the levy is collected in the manner described in Government Notice No. 895 of the 31st December, 1937, and farmers or others requiring further information on the subject are advised to write to the Secretary, Dairy Industry Control Board.

Registration of Dairy Premises.—The Dairy Act also makes provision for the registration of all premises which are used for the manufacture or production of milk and other dairy products. This includes premises which are used for the

manufacture of farm butter. In the case of farm butter dairies which are situated in rural areas, however, registration is not yet in force and will not come into operation until a date to be fixed by the Minister of Agriculture and Lands. It must be clearly understood that the registration of premises is quite a separate and distinct requirement from the farm butter licence previously mentioned, *i.e.*, premises may be registrable as a farm butter dairy, but the owner or occupier thereof would still not be able to sell farm butter, unless he held a farm butter licence issued to him by the Dairy Industry Control Board.

Farm butter makers are also required to comply with the Dairy Regulations contained in Government Notice No. 899 of the 31st December, 1937. These regulations, which came into force on the 1st January of this year, prescribe certain minimum requirements in regard to dairy buildings, miking conditions, etc. It is required, for instance, that milking operations shall be carried out in a cleanly manner and in an approved milking place; the dairyman must also provide a supply of pure wholesome water as well as proper facilities for the cooling of milk and cream and for the washing, boiling and steaming of all dairy utensils. All utensils have to be of approved type, and in the case of cans, buckets and similar receptacles, these have to be of seamless construction. A dairy must also be provided, but this need not be elaborate, provided it has certain essential features such as a cement floor and a ceiling and is fly proof and adequately ventilated and drained.

The dairy should also have a verandah, as this helps to keep the building cool. It is an advantage also if the separation of the milk can be performed outside the dairy on the verandah, and for this purpose a portion of the verandah measuring about 8 feet square could be cemented and screened off with fly proof gauze. This arrangement obviates to a great extent the necessity for the native employees having to enter the dairy, and this helps to keep the latter clean and free from flies. Further information regarding the requirements of the Dairy Regulations, etc., can be obtained from the Chief Dairy Officer, Department of Agriculture and Lands, Salisbury.

Marking of Butter Wrappers.—Any package containing farm butter is required under the Dairy Act to comply with the following conditions:—

(*a*) it must bear on the outside thereof in plainly visible printed capital letters the words "Farm Butter" and the name and address of the producer of such butter.

(*b*) the letters forming the words "Farm Butter" on the package must not be smaller than one-quarter of an inch square if the butter contained therein weighs one pound or less, and not smaller than one inch square if the butter contained therein weighs more than one pound.

(*c*) the letters forming the name and address of the producer on the package must not be smaller than one-eighth of an inch square if the butter contained therein weighs one pound or under, and not smaller than one-half of an inch square if the butter contained therein weighs more than one pound.

Standards of Composition for Farm Butter.—All butter, including farm butter, now has to comply with the following standard of composition.

1. It shall not contain less than 80% milk fat.
2. It shall not contain more than 16% of water.
3. It shall not contain more than 4% of sodium chloride (salt).
4. It shall contain no preservative.
5. It shall contain no colouring matter, unless approved by the Chief Dairy Officer (at certain times of the year), *i.e.*, during the winter it may be an advantage to use artificial colouring matter, in which case the use of "Annatto" colouring is permitted.

Grading of Farm Butter.—Provision is also made in the Dairy Act for the grading of farm butter. Farm butter is graded according to the same standards as creamery butter. The grading is carried out by dairy officers at various stores in the different towns. The procedure followed is to examine

at least 10 per cent. of the packages forming any consignment of farm butter manufactured by any one person. If not less than 10 per cent. of the packages are found to contain butter of a certain grade, then that particular grade is marked by means of a rubber stamp on all the packages forming the consignment, with the exception of any package which is actually found to contain butter of a different grade.

UTENSILS REQUIRED FOR BUTTER MAKING.

1. **The Churn.**—The end-over-end type of churn is recommended. This should be made of well seasoned oak or Kauri pine, fitted with means of ventilation and with a small window through which the state of the cream can be observed without removing the lid. The lid should be of sufficient size to enable the contents to be removed without any difficulty.

The churn must be kept scrupulously clean and sweet and when not in use should be filled with clean cold water.

At the first sign of mould growth or any offensive smell the churn should be soaked with a hot 10 per cent. solution of washing powder or a 15 per cent. salt solution and thereafter thoroughly washed with boiling water to remove all trace of the powder or salt solution.

Soaking the churn in a hot solution of lime—prepared by adding a handful of slaked lime to a couple of gallons of water—is also very effective in keeping the churn sweet.

Preparation of a New Churn.—Fill the churn with hot water to which a little washing soda has been added and allow to soak until all leaks are stopped. Run off this water and scrub thoroughly with hot water again, adding a little soda. Run off the water and half fill the churn with boiling water and give the churn a few turns, taking care to press the ventilator after each turn. If the preparation is complete the water should come off quite clear. The churn should then be well scrubbed with salt and filled with clean cold water to which a little lime may be added. A new butter worker should be treated in a similar manner.

Fig. 1.—Cream cooler in operation showing (1) water bag, (2) cooler and (3) cream receiving bucket.
(Photograph by S. T. Timson, Esq.)

Fig. 2.—Some of the essential equipment required for farm butter-making, viz., enamel pail, seamless container, quart measure, squeegee, sieve, scotch hands, butter scoop and thermometer.

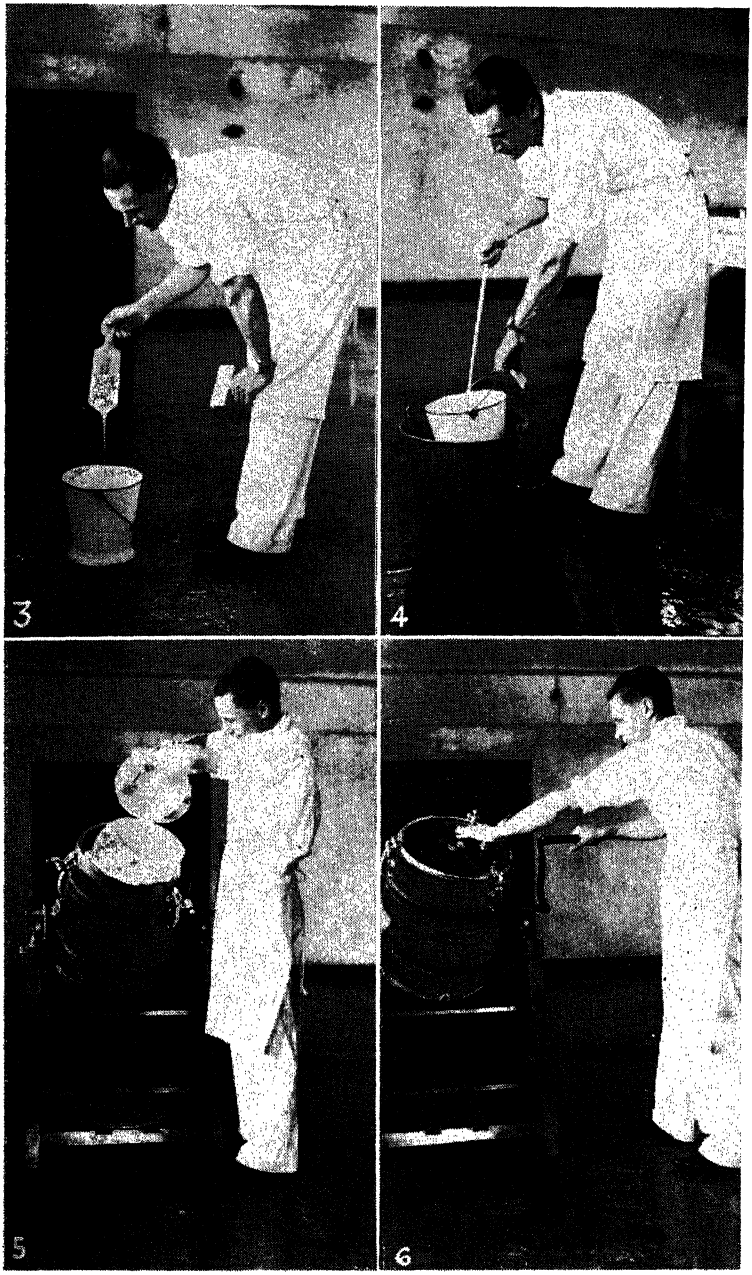


Fig. 3.—Testing the thickness of the cream. The cream should run freely off the scotch hand. The illustration shows cream which is too thick. Fig. 4.—The correct method of warming the cream for churning. The pail of cream is placed in warm water and thoroughly stirred. Fig 5.—Straining the cream into the churn. Fig. 6.—The churning process. Ventilating the churn.

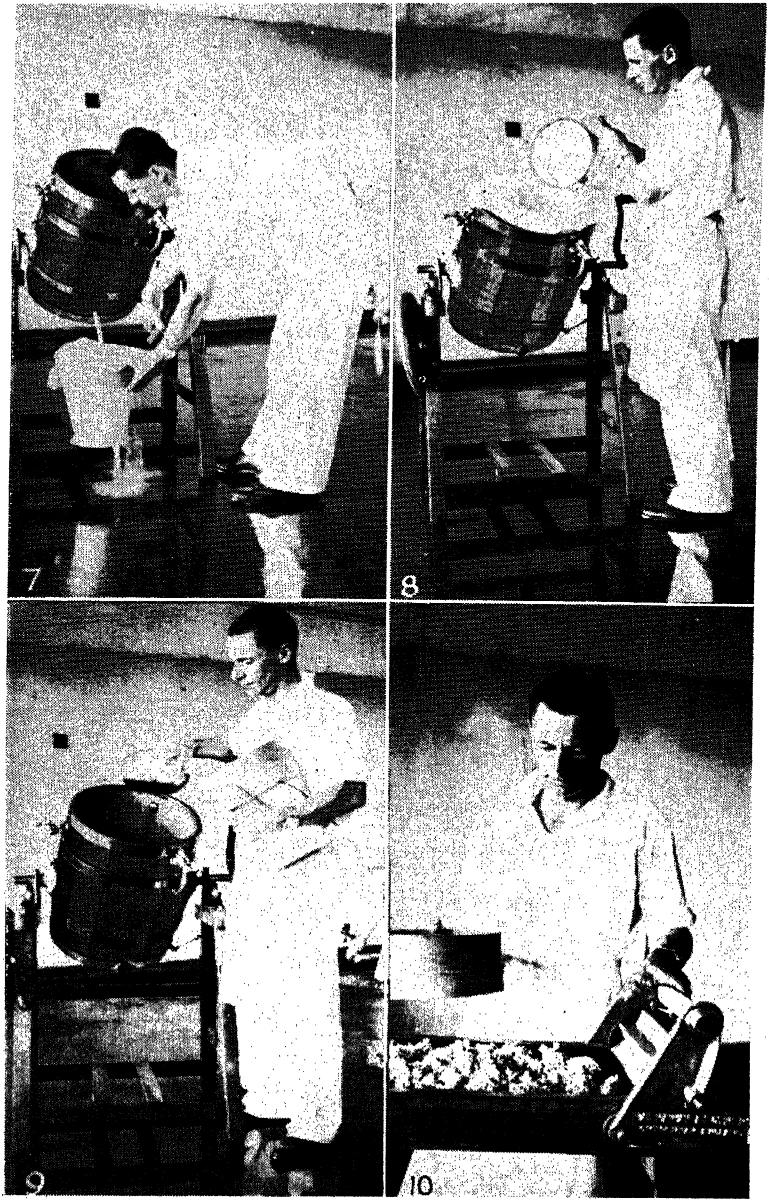
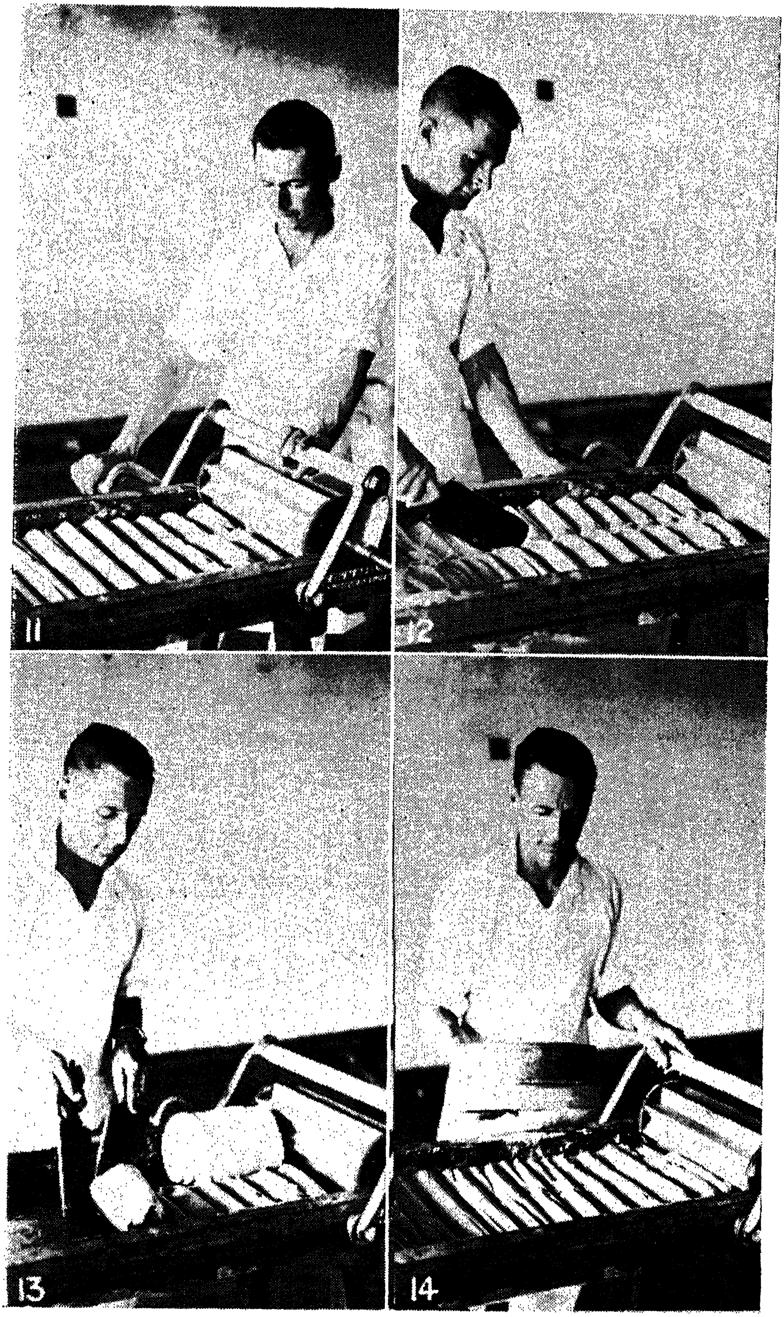


Fig. 7.—Removing the buttermilk when churning is completed. The buttermilk is strained through a sieve covered with muslin. Fig. 8.—Adding the brine which is strained into the churn. Fig. 9.—Removing the butter grains from the churn. The butter is transferred from the churn with a wooden scoop to a sieve held over a bucket. Fig. 10.—The grains of butter on removal from the churn are spread evenly over the worker. The butter is then ready for working, or if necessary, dry salting. If dry salting is practised then the salt is added in two portions and is sprinkled evenly over the butter through a sieve. The second portion is added 5 or 10 minutes after the first salting and working. See Fig. 14.



Figs. 11 to 13.—Working the butter. The roller is passed over the butter and the latter divided lengthwise with a scotch hand after each rolling and collected into two rolls and placed under the roller near the end of the worker.

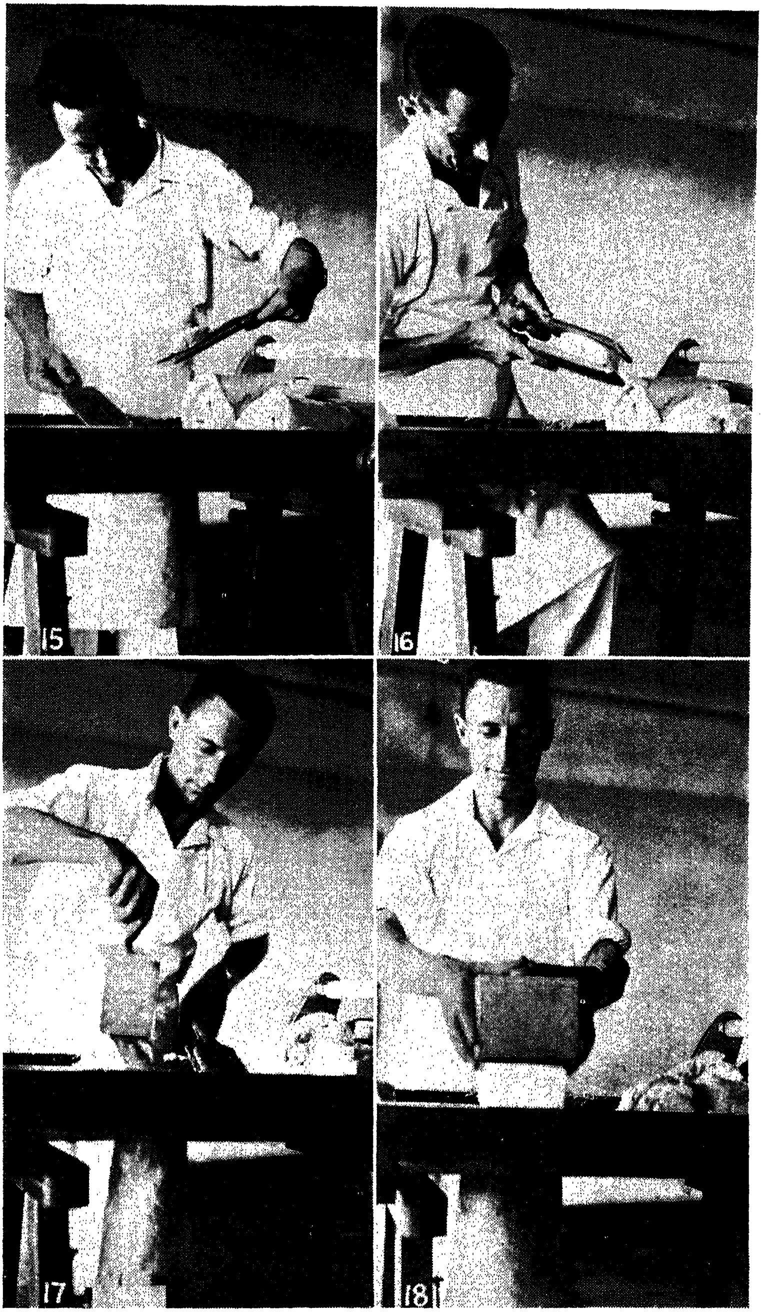


Fig. 15.—Examining the butter to see if it has been sufficiently worked. Fig. 16.—This illustrates the method for testing the butter for loose moisture. Figs. 17 and 18.—Moulding the butter into 1 lb. pats.

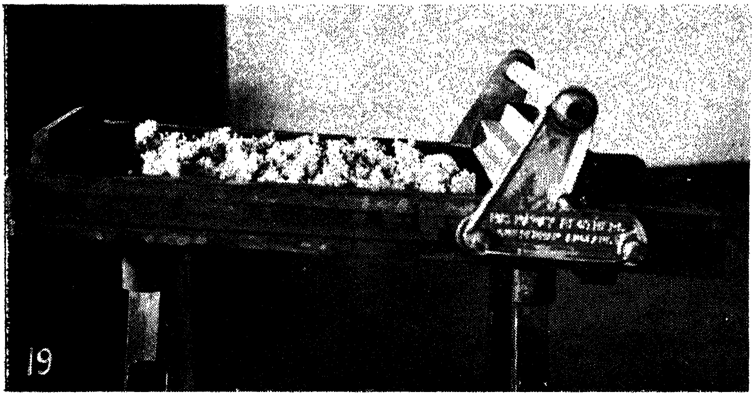


Fig. 19.—Illustration showing butter with good even grain.

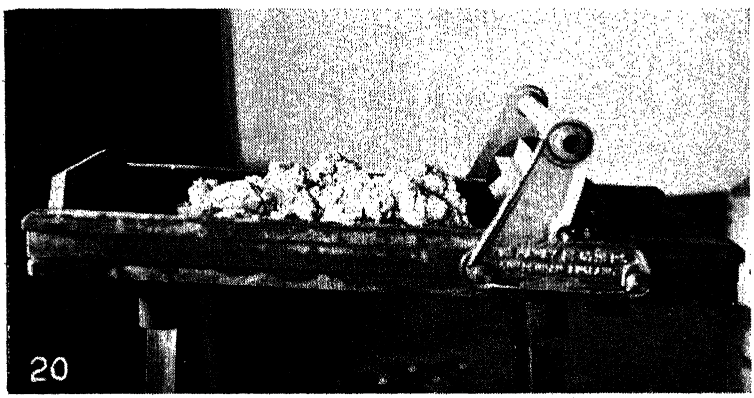


Fig. 20.—Illustration showing effects of over-churning. Note the lumpy appearance and that the grain of the butter has been destroyed.

2. **The Butter-Worker.**—This should be of the wooden tray type and fitted with a roller by means of which water can be expelled from the butter. It is almost impossible to work the butter properly by any other means, and the retention of water or butter milk as a result of insufficient working inevitably means poor keeping quality and "off" flavours in the finished product. The working of butter with scotch hands is usually unsatisfactory and generally results in the retention of excess moisture and a greasy textured butter. The butter-worker should be cleaned and treated in exactly the same manner as the churn.

3. **Scotch Hands, Butter Scoops.**—These are made of wood, and, like the churn, are scalded and kept sweet and clean when not in use.

4. **Hair Sieves and Butter Muslin** for draining butter milk and wash water from the churn.

5. **Thermometer.**—A dairy thermometer is an indispensable item of every butter-maker's equipment. Half the success in making good butter depends on the proper control of the temperature of the cream and wash water during the churning process. These temperatures cannot be controlled by guesswork and a thermometer is therefore absolutely essential.

PREPARATION OF UTENSILS FOR BUTTER-MAKING.

The Churn.—Fill to approximately one-third capacity with boiling water, screw down the lid and give a half turn, press down the ventilator to allow the steam to escape and turn again. Remove the lid, drain off the hot water and replace with the coldest water obtainable. Give one or two turns, remove the lid and allow the churn to hang downwards to drain. The churn is now ready for use. During the warm weather it may be necessary to prepare the churn the evening previous to butter-making, filling it with the coldest water obtainable (from water bags if necessary) and expose it with the lid removed, to the cool night air.

The Butter-Worker.—Scald the butter-worker with boiling water, paying particular attention to the scalding of the roller. Run off the hot water and replace with cold. Run the cold water off, and scrub with salt, leaving some damp salt on the roller. Replace the drain plug and fill the worker with the coldest water obtainable, giving the roller several turns round in the cold water and covering the whole with a wet muslin cloth which hangs over the roller into the water. Expose to the night air in warm weather. All wooden utensils such as scotch hands and the butter moulding box, etc., should be treated in exactly the same manner. The object of treating the utensils in the manner described is to prevent the cream or butter, as the case may be, from sticking to the surfaces with which it comes in contact.

THE HANDLING AND PREPARATION OF CREAM FOR BUTTER-MAKING.

This begins at the milking shed and the butter-maker should see that every precaution necessary for the production of clean milk and the proper treatment and handling of the milk and cream has been observed before the cream reaches the churning stage. For information on this subject butter-makers are referred to Bulletin No. 1051, "The Production and Handling of Milk and Cream," which gives full instructions for the handling and treatment of cream either for churning or for despatch to a creamery. A recapitulation of some of the more important points detailed in the bulletin mentioned may, however, be of service.

1. See that milking operations are carried out in a cleanly manner and in clean dust-free surroundings.

2. Do not allow the cows to drink in muddy, stagnant pools or sluggish streams.

3. See that feeds liable to taint the milk and cream, such as silage, etc., are always fed after milking, and that decayed, mouldy or musty foodstuffs are excluded from the ration fed to the milking cows.

4. Use seamless buckets for milking and see that all dairy utensils, including the separator, are properly cleaned and sterilised immediately after use.

5. See that the separator is properly mounted and properly manipulated. Flush the receiving tank and bowl with a gallon or so of boiling water before separating commences.

6. Separate the milk as soon as possible after milking and strain the milk into the separator. Don't separate at a temperature below 90° F.

7. Separate into clean empty vessels, such as enamel buckets, or, preferably, heavily tinned seamless pails.

8. Cool the cream as quickly as possible after separation by passing it over a surface cooler through which cold water is circulating. For preference the cream should run straight from the separator over the cooler into a bucket or seamless container (see fig. 1).

9. Don't mix warm cream with cream that has already been cooled. When thoroughly cool the fresh cream can be mixed with the older cream.

10. Keep the cream in an open receptacle covered with clean muslin in a clean, cool, airy place away from fruit, meat or other materials likely to cause taints.

11. Stir the cream at least three times a day, using a proper metal cream stirer for the purpose.

Ripening the Cream.—This refers to the changes the cream undergoes in flavour, aroma and consistency during the period between separating and churning.

The production of the clean, pleasant flavour and aroma characteristic of good butter has been shown to be associated with the development of acidity which normally takes place during the souring or ripening process to which the cream is subjected between separating and churning. Every butter-maker knows that sour or ripened cream not only churns more easily than sweet cream, but that it also produces butter with a sharper, more pronounced flavour, the flavour of butter made from sweet cream being usually flat and insipid.

The development of acidity during the ripening process, however, appears to have an adverse effect on the keeping quality of the butter, *i.e.*, farm butter made from sour or acid

cream usually has poorer keeping quality than butter made from sweet cream. Sweet cream, however, requires very much longer to churn and is apt to produce butter of a flavour which the public does not demand.

The aim of the butter-maker is, therefore, to ripen the cream just sufficiently to obtain easy churning and at the same time secure the desired flavour and keeping quality in the butter. The ripening of cream can be brought about in two ways.

(*a*) **Natural Ripening.**—The cream is allowed to ripen or sour in the natural way, the only treatment it receives being an occasional stirring. As the changes produced in the cream during ripening are the result of bacterial fermentation, it follows that where the cream is allowed to ripen naturally, the type of fermentation that takes place will depend very largely on the types of organisms which are present. If the cream has been produced under clean sanitary conditions then the predominant organisms present should be of desirable acid forming types; in this case natural ripening may give good results and produce a clean sound flavour in the butter.

If, however, the cream has not been produced under hygienic conditions, then the organisms present are likely to be of undesirable types which may give rise to gassy and other objectionable fermentations.

In the case of natural ripening therefore a great deal depends on the conditions under which the cream has been produced.

(*b*) **Artificial Ripening.**—This involves the use of "starters," or cultures of acid producing organisms. The culture, which is obtainable in liquid or powdered form, usually the latter, is inoculated into half a gallon or so of freshly separated milk which has previously been heated up to a temperature of 190°-200° F. for half an hour and thereafter cooled to 85°-90° F. This inoculated milk should be thick in 24 hours. A small quantity of the thickened milk—say, half teaspoonful or even less—is then inoculated into a second batch of freshly separated milk which has previously been heated up to 190°-200° F. as already described and cooled down to 70° F. The first lot of thick milk can then be discarded. For heating

purposes, the milk should be placed in a seamless utensil or enamel pail which should stand in water in an outer container; the heating can be done over a Primus or kitchen stove. This procedure has to be followed every day, *i.e.*, the thick milk has to be inoculated daily into a fresh batch of separated milk which is previously heated and cooled as described.

Full directions are supplied with the cultures referred to and these instructions should be very closely followed.

Artificial ripening is effected by adding a small quantity of the thickened starter to the cream. The amount of starter to add will depend on the time the cream is to be kept before churning, the season of the year and the temperature at which the cream is kept while ripening, etc. Generally speaking a tablespoonful or so per gallon of cream should be sufficient. This should be added just after the cream is separated and cooled. No starter need be added to the cream from the next separation if this is to be mixed and churned with the cream from the previous separation and to which starter has already been added.

The use of starters with which to ripen the cream has certain advantages, but it must be emphasised that unless the greatest of care is exercised in the preparation of the starter and every precaution observed to see that the utensils and other apparatus with which it comes in contact are properly cleaned and sterilised, the starter may become contaminated with organisms capable of giving rise to undesirable fermentations; in this case the addition of starter to the cream may seriously impair the quality of the butter.

Experience has shown that butter-makers continue in many cases to use starters long after they have become contaminated or are otherwise defective, and for this reason the artificial ripening of cream is not advocated as a general practice for farm butter making.

Ripening Temperature.—The temperature at which the cream should be ripened depends, amongst other factors, on the period for which the cream has to be kept before churning and the method of ripening that is practised. Generally speaking it is advisable to ripen the cream at a temperature of 60°-65° F. Below these temperatures acid development may

be slow, particularly if natural ripening is practised. If starter is used, however, the cream may be quite successfully ripened at temperatures below those indicated. A temperature of 60°-65° F. can usually be quite easily maintained during cold weather, but it is difficult to keep the cream at this temperature during the hot summer months without the aid of a refrigerator or some special cooling device.

A refrigerator is really an essential item of equipment for successful buttermaking in this territory during the summer months, for, as will be shown later it is frequently necessary during the warm weather to churn the cream at temperatures as low as 52°-54° F., and it is practically impossible to reduce the temperature of the cream to this point without ice or artificial refrigeration. When using a refrigerator, however, it should be remembered that the latter is actually an air-tight compartment and that warm fresh cream placed therein is very liable to absorb flavours and taints from other foodstuffs such as meat, etc., which may be present. The cream should first be cooled over an open surface cooler of the type previously mentioned; this has the effect of not only cooling the cream rapidly but also of liberating some of the odours and gasses that may be present. When the cream has been cooled it may be placed in the refrigerator.

As previously stated, however, the cream should be ripened at a temperature of 60°-65° F.; if it is not practicable to maintain this temperature in the refrigerator then it would be advisable to keep the cream out of the refrigerator until the ripening process is complete; the cream may then be placed in the refrigerator and cooled down to churning temperature.

THE PREPARATION OF CREAM FOR CHURNING.

When preparing the cream for churning attention should be given to the following:—

(1) The consistency of the cream.

(2) The ripeness of the cream.

(3) The churning temperature.

(1) **The Consistency of the Cream.**—When the cream is ready to churn it should not be too thick, otherwise it will stick to the sides of the churn and cause difficult churning and a loss of fat in the buttermilk. If the cream is of the right consistency it should run off a wooden stirrer or scotch hand without clinging to it. If the cream is too thick it can be thinned down to the desired consistency with cold water, the temperature of which should be the same as the churning temperature of the cream.

Generally speaking, the cream when ready for churning should test about 35% of butter-fat. It is usually advisable during the summer months to separate a cream testing 40-45% of butter-fat, as cream of this consistency is less liable to become over-acid than a thinner cream. The cream can be thinned down for churning with cold water as already described. During the winter months a thinner cream can be separated.

It is also of the greatest importance that the cream should be thoroughly mixed and blended for churning. Where different lots of cream have to be churned together they should be thoroughly mixed and blended at least several hours before churning. If the cream is to be churned in the morning then the mixing and blending should be attended to on the previous evening.

Failure to observe this precaution may result in butter of streaky appearance and considerable loss of fat in churning.

(2) **The Ripeness of the Cream.**—When sufficiently ripe for butter-making the cream should have a clean sharp acid flavour and a smooth velvety appearance. The acidity should be about 0.4%-0.5% lactic acid. This is, however, only a rough guide, as the degree of acidity to which the cream can safely be ripened depends on the percentage of butter-fat it contains, *i.e.*, cream testing 30-35% of butter-fat can be ripened to higher degree of acidity than cream testing 45-50%. Experience will guide the butter-maker in deciding whether the cream is ripe enough for churning; generally speaking the cream should be ripened sufficiently to churn—at the correct temperature—in 25 to 30 minutes.

Generally speaking cream which has been ripened at the proper temperature should be ready for churning in 48 hours so that it is usually necessary to churn three times a week during the summer months.

(3) **Churning Temperature.**—This is of extreme importance. The churning temperature may vary from 50° to 60° F., or even several degrees above or below these temperatures, depending on the ripeness of the cram and its other characteristics. Sweet cream, for instance, should be churned at a lower temperature than ripe cream, whilst thin cream should be churned at a higher temperature than thick cream.

It is not possible, therefore, to prescribe a definite churning temperature that will produce satisfactory results under all conditions or with all types of cream. The temperature at which the cream should be churned depends also upon the character of the butter-fat, and this in turn is influenced by a number of factors such as the season of the year, the period of lactation and food consumed by the cows. During the spring and early summer when the cows are feeding on green pasture, the butter-fat is usually soft and the cream has to be churned at low temperatures for the best results; later on in the year, however, and particularly during the winter months, when the cattle are on dry feed, the butter-fat is very much harder and higher churning temperatures have to be employed.

Experience will indicate the most suitable churning temperature for the locality and conditions under which the butter is being made. The control of churning temperature is usually the greatest difficulty the farm butter-maker has to face, especially during the hot summer months. Every effort must be made, however, to avoid the results of churning at too high a temperature. It should be borne in mind that in order to work, salt and wash the butter properly it must be churned to a grain of the correct size. When the churning temperature is too high, instead of a fine grain forming, large grains, or even solid lumps, appears when the cream "breaks." (See fig. 20).

These lumps contain quantities of butter-milk and curd, ideal media for the development of organisms which cause "off" flavours and rapid deterioration in quality. Once the lumps have formed, no amount of washing or working will remove the butter-milk, nor will it be possible to incorporate the salt evently; under these conditions the butter is almost certain to be defective in flavour and to have a weak, leaky or greasy body and a mottled or streaky appearance. High churning temperatures are invariably associated also with excessive loss of fat in the butter-milk. Low temperatures on the other hand usually cause prolonged churning and the formation of small hard grains of butter in which moisture and salt can be incorporated only with the greatest difficulty and after excessive working, as a result of which the body is usually impaired.

The following table will serve as a rough guide for churning temperatures under ordinary conditions:—

Temprature of Dairy.	Churning Temperature.
68° F.	53° F.
66° F.	55° F.
64° F.	56° F.
62° F.	57° F.
60° F.	58° F.
58° F.	59° F.
55° F.	60° F.
50° F.	62° F.

If the proper temperature is observed the churning period should occupy from 25 to 30 minutes. It is also essential that the cream when brought to the desired churning temperature should be held there for some time, at least three or four hours, and preferably longer if this is practicable. The longer the cream can be held after being cooled down to churning temperatures, the firmer will be the body of the butter. If the cream is churned immediately after being cooled a rapid rise in temperature may take place, during the churning process, and the result will be a soft, weak, leaky bodied butter.

During the winter months it is frequently necessary to raise the temperature of the cream for churning purposes. A common procedure is to add hot water to the cream, but this

is a very bad practice, as it causes a weak greasy bodied butter. The correct method of raising the temperature is to place the can of cream in water at a temperature of 80° to 90° F. and to stir the cream thoroughly until the desired temperature has been reached. The cream should then be held at churning temperature for several hours.

Artificial Colouring.—As indicated elsewhere the use of "Annatto" colouring matter in butter, although not recommended as a general practice, is permitted under the Dairy Act. During the winter months in this Colony butter is inclined to be pale in colour due to lack of green feed for the cows, and the use of colouring matter may then be advantageous. The amount of colouring to use will depend upon the shade of colour required and the season of the year. Generally speaking a teaspoonful of colouring to 4-5 gallons of cream added to the cream just before churning should give the desired shade of colour.

Running the Cream into the Churn.—When the cream is ready for churning it should be poured into the churn through a muslin cloth. This will have the effect of breaking up any lumps and also of removing any curd particles which, if not removed, will cause white spots to appear in the butter and lead also to the development of "off" flavours. The remnants of cream are removed from the bucket by means of a squeegee and any cream remaining in the straining cloth is squeezed through into the churn. The churn should never be filled to more than one-third of its capacity.

The Churning Process.—Begin churning slowly and ventilate the churn every four or five revolutions until no more air or gas escapes when the ventilator is pressed. Then increase the rate of turning to that fixed for the type of churn used, and turn regularly until the cream "breaks" and the granules of butter appear on the peep glass. Practice will enable the butter-maker to tell by the sound and feel of the churn when "breaking" is about to take place.

When the cream breaks the churn should be stopped and a quart of cold "break" water added for every three gallons of cream in the churn. The temperature of the break water should be 2 or 3 degrees below churning temperature. Replace

the lid and turn slowly two or three times until the grains are the size of rather large shot. When the grain is of the right size draw off the butter milk, using a hair sieve (covered with butter muslin) to catch any grains which may be washed out with the butter milk.

Washing the Butter.—The object of washing is to remove the butter milk, and whilst the last of the butter milk is draining from the churn, the washing water should be prepared. Clean cold water only should be used. It should be about 4 degrees lower than the churning temperature. In summer the coldest water obtainable should be used for this purpose, and if salt is used to form a weak brine, so much the better, as the addition of salt will bring down the temperature from 1 to 2 degrees. After the drain plug is replaced pour sufficient washing water into the churn to float the butter. Replace the lid and give the churn four or six sharp turns.

Drain off the first wash water and wash again, using water at temperature 2 or 3 degrees lower than the first wash water. Two washings are usually enough, as excessive washing has the effect of bleaching the colour and causing loss of flavour.

Salting the Butter.—Brine salting is recommended for fresh butter. A brine made in the proportion of one pound of salt to one gallon of water will give a sufficient degree of salting for most markets if the butter is left in the brine from 20-25 minutes. A stronger brine left in the butter for a longer period will give a more highly salted butter. The brine should always be strained into the churn, to prevent specks of dirt or granules of undissolved salt getting into the butter. Sufficient brine should be used to float the butter grains.

The Advantages of Brining.—(1) The addition of salt to the water brings down its temperature about two degrees, and this in the summer firms up the grain to a very considerable extent.

(2) It improves the flavour and, being evenly distributed, obviates the formation of white streaks through the butter.

(3) The butter requires less working and can be made up at once.

Dry Salting.—Dry salting is not recommended, although it economises salt. Dry salting very often results in mottles and streaks being formed, and the butter is often full of particles of undissolved salt. The amount of salt varies according to taste. One-half to three-quarters of an ounce of salt to one pound of butter will give a fairly heavy salting, but these proportions can be exceeded if so desired. Only the finest quality of salt should be used and it should be pure white in colour, fine in texture and free from dirt and impurities, and should contain 99% or more of sodium chloride.

The butter, when in the grain stage, is spread over the worker and one half of the required amount of salt sprinkled evenly over the surface through a hair sieve. A little cold water should then be sprinkled over the salt to help dissolve it and the butter worked, three or four times and allowed to stand for 5 to 10 minutes—covered with a damp muslin cloth to allow the salt to dissolve. The second portion of the salt is now added and the working completed.

Removing Butter from Churn.—The butter, after remaining for about 20 to 25 minutes in the brine, should be removed from the churn by means of a butter scoop on to a sieve. The sieve is held over a bucket which catches the drippings, and when the sieve is full the butter is transferred to the butter worker. If all the butter cannot be removed from the churn at one operation, the butter already in the worker should be covered with a wet muslin cloth until the next portion is placed with it. The few grains of butter which cannot be gathered, or which cling to the sides of the churn, can be washed through the plug hole with the brine and caught in the sieve. Care should always be exercised in taking the butter out of the churn so as not to scrape it against the sides of the churn, as this may cause the latter to become greasy and sticky.

Working the Butter.—The butter grains, upon removal from the churn, are spread over the surface of the worker and the roller gently passed over them. Great care should be taken at this stage not to rub the butter with the roller. The roller is so constructed that, properly manipulated, it will give the requisite pressure to work the butter without any rubbing or friction. No more butter should be placed on the

worker than can be conveniently worked. Each time the roller has been passed over the butter the latter should be collected with the aid of the scotch hands into two rolls and placed under the roller near the end of the worker. After 8 to 10 workings it will be found that the butter is sufficiently dry. Well worked butter should be just so dry that, when cut and squeezed between two scotch hands, only a drop or two of water appears on the surface; at the same time it should break with an even granular fracture, showing the grain quite distinctly like broken steel.

Properly made butter should not contain more than 16 per cent. of moisture. This, as previously stated, is a requirement of the Dairy Act. In the winter months, owing to the hardness of the fat and other factors, it is difficult to incorporate 16 per cent. of moisture in the butter, but during the summer months when churning temperatures are high, the percentage of water incorporated in the butter may exceed the legal standard; samples of farm butter have frequently been found to contain as much as 27% of water. Over churning, especially at high temperatures, frequently results in the retention of excess moisture in the butter.

Do not Overwork.—Too much working is a common fault of farm butter. Such butter has a dull, greasy appearance and its texture is spoiled.

Do not attempt to work the butter when too soft, otherwise the butter will become greasy and it will be impossible to work the moisture out of it properly. If the butter is too soft to work, it should be spread out on a plate or tray, covered with damp muslin dipped in brine and be left in a draught or in as cool a place as possible until firm enough to be worked. During the summer months the working should be done either at daybreak or before if possible.

Making Up, Wrapping and Packing the Butter.—If any quantity of butter is made the printing is most conveniently done with a small hand printing machine. Failing this, the butter can be made into 1 lb. pats with a pair of scotch hands or by means of a small wooden mould, but care should be exercised to see that the butter is not too soft, otherwise it may become greasy. Care should also be exercised to see

that the butter is made up into neat, uniform, rectangular packages, which should be wrapped in the best quality white vegetable parchment paper measuring $11\frac{1}{2}$ inch x $8\frac{1}{2}$ inch. Small wrapping papers are unsatisfactory. The wrapper should bear the words "Farm Butter" and the name and address of the producer as required under the Dairy Act. The actual method of wrapping the butter is another matter which, at times, does not receive sufficient attention. Loose corners and ends detract from the appearance of the butter and should be avoided. The diagrams in fig. 21 illustrate the correct method of wrapping butter.

The wrappers should be soaked in cold water, or preferably brine, before use. Butter wrappers should always be kept in a clean dry place and be protected from dust, otherwise they may become infected with mould spores and cause spots of mould to appear on the surface of the butter when subsequently used for wrapping. Wrappers which are contaminated with mould can be disinfected by soaking for a couple of hours in hot strong brine prepared by dissolving $1\frac{1}{2}$-2 lb. of salt in water.

As soon as it is wrapped the butter should be placed in an ice chest or refrigerator; failing this it should be covered with wet butter muslin and kept in a cool place. Special boxes of some odourless wood should be provided for packing the butter; before packing, the box should be lined with vegetable parchment or butter muslin. For packing farm butter a flat shaped box containing two layers of butter is to be preferred to a deep box containing five or six layers. The box containing the butter should at all costs be protected from the heat of the sun.

Treatment of Utensils after Use.—The churn should be almost free from butter after the brine has been run off. It should be washed with warm water and all traces of butter removed with a brush. Give the churn a few turns, ventilating frequently and let out the warm water. Next fill the churn to half capacity with boiling water, add a small quantity of washing powder and revolve the churn a few times, taking care to press the ventilator at each turn. Run off the water, remove the lid, and turn the churn upside down to

drain and dry. The rubber band should be washed separately in warm water containing washing powder and then finally washed in cold water. The rubber band should on no account be hung up to dry, as this causes the rubber to stretch. All metal work should be dried and polished.

The butter worker, scotch hands, sieve, etc., should be well scrubbed with a brush and hot water after a preliminary washing. The butter muslin should be washed and scalded and hung up to dry. All utensils should be neatly arranged on the butter worker and the dairy washed down with boiling water and left to dry.

CHURNING DIFFICULTIES.

1. **Sticky Churns.**—Occasionally difficulty is experienced in preventing the butter from sticking to the sides of the churn and rollers of the worker, etc. In most cases this is due entirely to not having chilled the churn, etc., sufficiently before use. In such cases the difficulty may be avoided by paying strict attention to the final rinsing of the churn, worker, scotch hands, etc., with the coldest water obtainable before being used for churning or working purposes.

Not infrequently the wooden equipment does not respond to this treatment and the butter continues to stick. This is probably due to the fact that the utensils have not been properly cared for and the pores of the wood have become choked with fat and milk solids. An effective remedy in this case is to lime-wash the affected articles, allowing the lime to dry and remain on the equipment for several days. Before use again the churn, etc., should be thoroughly scrubbed with hot water to which a liberal quantity of washing powder has been added.

2. **Prolonged Churning.**—This is most common in the winter months, when the cows are well on in lactation and are on dry feed. At times the combination of these two factors renders the cream very difficult to churn. Prevention is better than cure, and if the butter-making returns warrant it, the calving programme should be so arranged that fresh cows will be coming into milk every month or two. It is especially necessary to provide succulent feeds, such as maize

ensilage or green feed, etc., during the colder months, as this will tend to reduce the proportion of hard fats and thus induce easy churning with a far more delicate flavour in the resultant butter. Certain concentrates such as cotton seed meal, when fed in excessive quantities, may produce a hard tallowy butter fat which may be slow to churn. Properly combined with other foodstuffs, cotton seed cake has very little effect on the butter fat and is indeed a very valuable concentrate. Similarly maize meal when fed in large amounts, particularly when combined with coarse dry fodders such as maize stover, etc., may produce an abnormally hard butter. Linseed meal, on the other hand, produces a soft butter when fed alone or in large amounts.

Prolonged churning is, however, more commonly caused by one or more of the following:—

(*a*) Churning at too low a temperature. The remedy here is to remove the cream or portion thereof from the churn and warm it up, as previously described, to the correct churning temperature. Check the accuracy of the thermometer used.

(*b*) Failing to ripen the cream sufficiently before churning. The acidity should be between 0.4% and 0.5% as determined by the acidimeter test. (See Bulletin No. 880, Dairy Tests and Calculations.)

(*c*) Churning cream when too thick. As already indicated the correct consistency is about 35% butter fat, but this may be further reduced if circumstances demand it.

(*d*) Not allowing the cream to remain at churning temperature long enough to permit the fat globules to take up this temperature. At least 3 hours should be taken for this purpose and preferably longer.

(*e*) Overfilling the churn. Under no circumstances should the churn be more than one-third filled.

(*f*) Abnormal fermentations in the cream causing excessive viscosity.

3. **"Sleepy" Cream.**—This refers to cream which froths abnormally during the churning process and sticks to the sides of the churn with the result that agitation within the

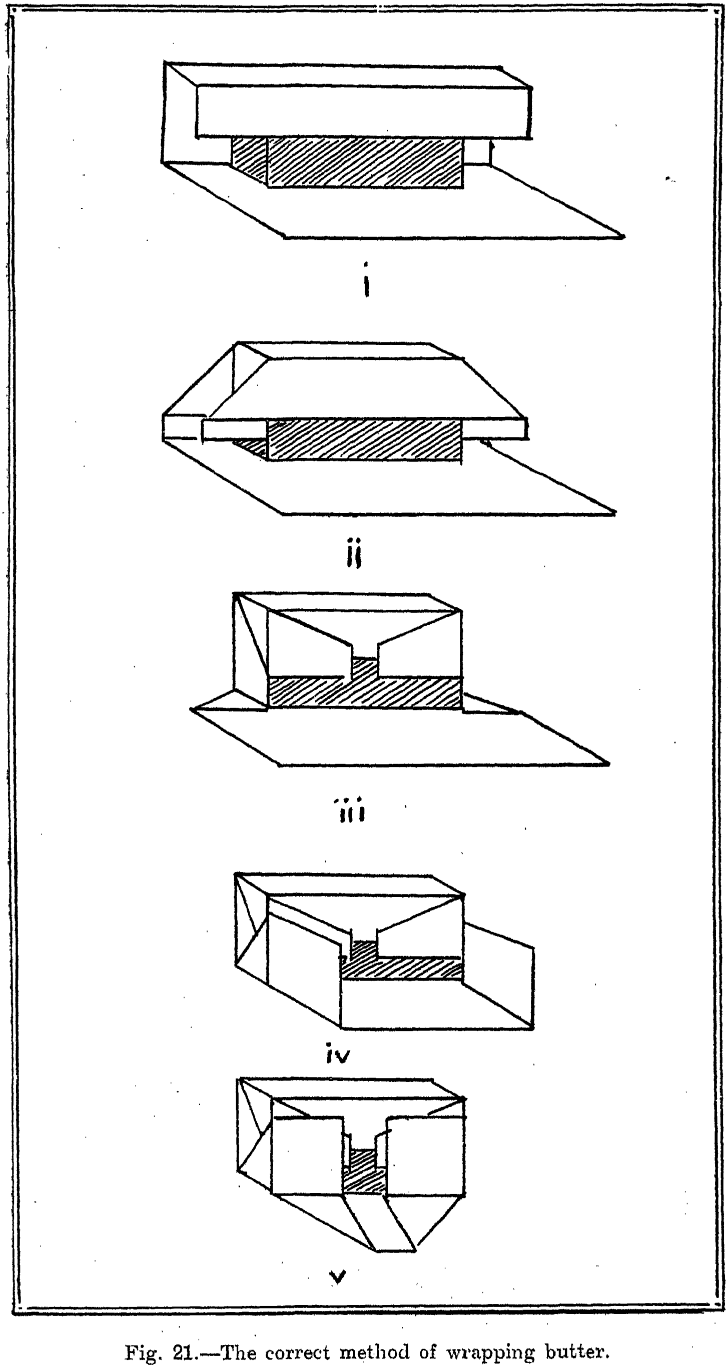


Fig. 21.—The correct method of wrapping butter.

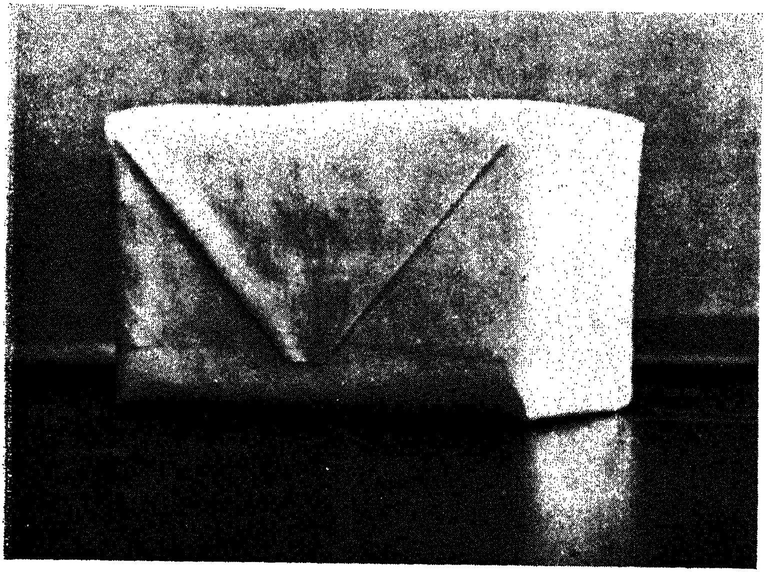


Fig. 22.—A neatly wrapped pound of butter. Note absence of loose ends.

Fig. 23.—Untidy wrapping.

Fig. 24.—Butter showing good grain and texture.

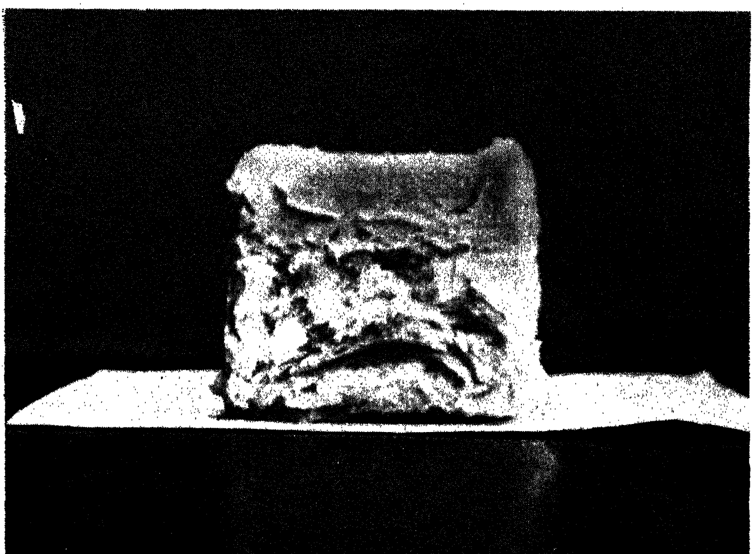


Fig. 25.—Butter showing very poor texture, the result of over-churning or over-working.

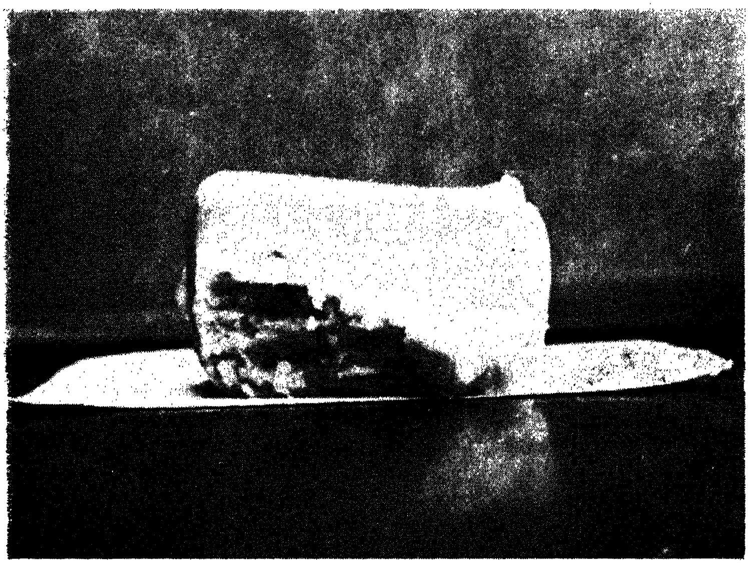


Fig. 26.—A sample of streaky butter.

churn practically ceases. The cream may also become very viscous. The difficulty may at times be overcome by pouring warm water on the outside of the churn and allowing the cream to stand motionless for a while, after which churning can usually be completed. Occasionally, however, the cream absolutely refuses to churn and has to be discarded. "Sleepy" cream is not common in this territory. The addition of a handful or so of dry salt to the cream in the churn is also of great assistance at times in overcoming churning difficulties.

Preserving Butter.—It is extremely difficult in a semi-tropical country to preserve butter for any length of time without artificial refrigeration. On some farms, however, butter is none too plentiful during the winter and an effort has to be made, therefore, to preserve some of the butter made in the summer for winter use.

In this case the cream from which the butter is made should be fairly sweet, *i.e.*, it should have a very slight acid flavour. It should be churned at a low temperature 2°F.-3°F. lower than usual. Churning should cease when the grains are about one-half the size of Kaffir corn kernels, and the butter washed thoroughly in three or four wash-waters, until all traces of butter milk have been removed. Butter, for preserving purposes, should be dry salted, and, as an excess of salt has a preserving effect, liberal quantities should be used, *i.e.*, 1 oz. of salt to each lb. of butter.

Only the finest dairy salt should be used, and it is advisable to add it in three applications as outlined under the heading "Dry Salting," but allowing at least 30 minutes between each application to permit the salt to dissolve thoroughly.

The working of butter for preserving purposes is a most important matter, and care should be taken to work it as dry as possible without causing greasiness. It is for this reason that slightly lower temperatures are advocated which will permit of thorough working resulting in a drier body and complete incorporation of the salt. The drier the butter, the better it will keep.

After working, the butter should be packed in a glazed jar or fruit jar which has been thoroughly scalded beforehand. The butter should be pressed firmly into the jar so as to leave no air spaces. When the jar is filled to within a quarter of an inch of the top, a piece of parchment paper is placed over the butter and covered with a good thick layer of dairy salt which is brought flush with the top of the jar. The jar is then sealed or tied down with parchment paper as the case may be and stored in the coolest place obtainable.

When required for use, the butter is removed from the container and soaked for an hour or two in water at a temperature of 60-65°F. and is then re-worked, being sprinkled at the same time with water to reduce the saltiness.

Another method of preserving butter is by "pounding" it, wrapping it in muslin instead of butter paper and storing it in strong brine. A piece of thread fastened longways round the pounds of butter will prevent the wrapping from working loose. A round lid, somewhat smaller than the cask in which the butter is stored, is floated on the brine and enough weight placed upon it to keep the butter well under.

SOME COMMON DEFECTS IN FARM BUTTER.

Defects commonly found in farm butter may be divided into three classes:—

1. Defects in flavour and aroma.
2. Defects in body and texture.
3. Defects in colour.

1. **Defects in Flavour and Aroma.**—The true flavour of high-class butter is very difficult to define. Butter should have a delicate, nutty, clean flavour, pleasing to the palate. The following are the most common defects in flavour:—

(1) **"Flat" Flavour.**—Butter which is lacking in flavour, but which is otherwise free from objectionable flavours or taints, is termed flat or insipid. This is one of the commonest defects of butter, and is generally caused by one or more of the following:—

i. Lack of green or succulent feed, especially in the winter.

ii. Ripening of cream at too low a temperature or churning the cream before sufficient acidity has been developed.

iii. Excessive washing of the butter whilst in the granular stage.

iv. Excessive dilution of the cream with water for churning.

Butter which is under-salted frequently has an insipid taste; salt in moderate and correct proportion always brings out the delicate flavour and improves the appearance of the butter by deepening the colour.

(2) **Stale Flavour.**—Staleness is generally characteristic of butter made from old, stale or over-ripe cream, or it may be caused by the use of cream obtained from the milk of cows far advanced in lactation. A more frequent cause, however, is the use of rusty cream receptacles for ripening the cream.

(3) **Sour Flavour and Aroma.**—This is a common defect in hot weather in farm butter and is usually caused by allowing the cream to become too sour before churning.

(4) **Cheesy Flavours.**—These flavours are generally caused by decomposition of the protein matter or curd (derived from butter milk) retained in the butter owing to faulty washing. This is a defect common during the summer, when it is almost impossible to make butter on the farms without the use of ice. If such butter is maintained at ordinary summer temperatures the flavour goes "off" in two or three days, and if stored any length of time becomes absolutely obnoxious. To avoid the development of this cheesy flavour it is necessary to use all available means to get the cream and washing water as cool as possible. Cheesy butter is often full of white specks. These are particles of curd which are incorporated in the butter, either through neglecting to strain the cream when it is put into the churn or by over-churning the butter. In the latter case it is obviously impossible to get rid of the butter milk and portions of hardened curd by washing.

(5) **Bitter Flavour.**—This flavour has been noticed very frequently when droughty conditions were prevalent. At these times cows are usually to be found grazing in the vleis

where the herbage is usually of a rank, sedgy nature. This grazing apparently causes bitterness in the milk and cream; a bitter flavour may also be caused by certain feeds and weeds, and it is frequently found in the milk and cream obtained from cows far advanced in lactation. Cream which is not sufficiently stirred while ripening is also prone to develop an unpleasant bitter taste. Bitterness in butter is also quite frequently caused by the use of impure salt containing comparatively large amounts of magnesium and calcium compounds.

(6) **Mouldy or Musty Flavour.**—A mouldy or musty flavour in cream and butter may be caused by feeding mouldy and musty feeds. Cream which is ripened in a closed can or other receptacle on which a lid has been placed, generally develops a peculiar musty flavour which may subsequently appear in the butter. This defect is most readily prevented by prompt cooling and frequent stirring of the freshly separated cream; the latter should be exposed to the air as much as possible whilst cooling and ripening, and this is best achieved by placing a piece of butter muslin over the mouth or opening of the receptacle or vessel containing the cream. Cream should at all times be kept in a cool airy place. Any dark, dusty, unventilated place is conducive to the formation of mould; the latter will not develop if the dairy is kept thoroughly clean and the walls frequently whitewashed.

Mould is often caused by the use of cheap unsuitable boxes for the butter, such as soap boxes, etc. If these boxes are at all damp or are kept in a damp place for any length of time, mould is almost certain to develop. Thick inferior butter paper is another frequent cause of mould.

(7) **Tallowy Flavour.**—Tallowy butter has a distinct taste and odour of spoiled tallow, and is usually bleached in colour or entirely white. Tallowiness generally develops in butter stored at room temperatures, and is generally considered to be caused by decomposition of the butterfat, a process which is encouraged by exposure of the butter to air, light and warmth. These conditions are generally satisfied when butter is kept for any period on the average farm or in stores, etc., and for this reason tallowiness is a defect common to much of our farm produced butter.

The use of old, rusty dairy utensils, cans, etc., also favours the development of a tallowy flavour in butter. Tallowiness can be almost entirely avoided by handling the cream in non-rusty cans, etc., and by storing the butter under conditions where it is not unduly exposed to the air, light, heat, etc.

(8) **Unclean Flavours.**—An unclean flavour in butter suggests careless methods of production and the use of dirty or unsanitary utensils.

Unclean flavours may be imparted to butter by the presence in the milk, cream or butter, of decomposed milk solids, or by the use of unclean wash water left in the dairy utensils. A high standard of cleanliness and the use of seamless utensils is the only effective method of overcoming this defect.

(9) **Rancid Flavour.**—A rancid flavour is usually to be found in butter which has been stored for some time, although badly made farm butter often turns rancid within a week. Rancidity is the result of decomposition of the butterfat, a process usually brought about by organisms present in the butter. Cleanliness in production and the observance of all the precautions necessary for the manufacture and storage of the butter are the most effective means of overcoming this defect.

(10) **Yeasty Flavour.**—This flavour is usually a hot weather defect and is due to the presence of yeast cells in the cream. The flavours arising from such contamination are of great variety, but all are objectionable. The yeasty fermentation is invariably characterised by the vigorous formation of gas causing the cream to rise and froth over. This defect can be prevented by the exercise of sanitary methods of production and the proper cooling of the cream after separation. An unclean separator is a common cause of this defect.

2. **Defects in Body and Texture.**—Properly made butter has a firm, solid "body" and a consistently waxy, close texture. When the butter is first formed in the churn it makes its appearance in the shape of minute irregular granules. In the subsequent process of manufacture, if the butter is properly made, these granules never completely lose their

individuality, and they constitute the so-called granular appearance which is noticeable when the butter is broken. The more distinct the granules, the better the texture. When the butter is cut, no particles of fat should adhere to the knife.

(1) **Weak and Greasy Body.**—These are common faults of butter made in the warmer season of the year, but even in the winter weak-bodied butter, because of overworking, is only too common. The fundamental cause of a weak body is neglect to cool the cream properly prior to churning. Butter-fat is composed of a mixture of fats of different melting points, and it is obvious that although some of these fats may be chilled, others may be in a semi-liquid state. It is these semi-liquid fats which cause a weak-bodied butter. If this defect is to be avoided it is essential to hold the cream at a low temperature for some considerable time. When it is impossible to reduce the temperature of the cream to a sufficient degree, churn the butter carefully, adding plenty of breaking water, and allow the butter granules to harden in brine made with the coldest water obtainable. By this means it can be handled and worked without serious danger of its becoming greasy.

Soft butter should never be worked. It should be placed in a flat dish with a damp muslin cloth, and exposed to a draught until such time as it is hard enough to be worked and made up.

2. **Leaky Body and Texture.**—Such butter when broken or squeezed between two scotch hands shows drops of water on the broken surface. Butter which has been properly churned and worked is dry in appearance and only by exerting great pressure can a drop of water be made visible.

Leaky butter is usually caused by over-churning, under-working or by churning at too high or too low a temperature. During the summer months, over-churning is very common and is difficult to avoid unless the temperature of the cream can be controlled. Over-churned butter contains a lot of moisture which no amount of working will eradicate. Under-working has the same effect in that not sufficient pressure has been applied to the butter to bring the grains together close

enough and so distribute the water evenly and in minute droplets throughout the mass of the butter. Leaky butter usually has poor keeping qualities.

(3) **Brittle and Crumbly Texture.**—This defect usually occurs in the winter months when the cows are on dry feed and the butterfat is excessively firm and hard. The only effective remedy is to provide green or succulent feeds during the dry months.

3. **Defects in Colour.**—The colour of butter must be of the shade and intensity desired by the market in which it is sold. For local purposes a medium shade is required.

It is generally accepted that the natural colour of cream and butter is derived from certain yellow pigments which accompany the chlorophyll or green colouring matter of plants. While most green foods, yellow roots, etc., contain these pigments in abundance, they are generally lacking in dry feeds and concentrates. This explains why the colour of butter in spring is of a much deeper shade than that of butter made in the winter, when the cows are being fed largely on dry hay or mealie stalks, supplemented with mealie meal, bean meal or other concentrates. It is remarkable how well-got hay, with the original green colour still retained, maintains the colour of the butter in the winter. Such hay is, of course, of much higher feeding value than the dried grass which is so commonly cut in this country.

The breed of cattle also affects colour. It is well known that the Jersey and Guernsey breed give highly coloured cream even in winter, whilst that of the Shorthorn and the Friesland, under similar conditions, is almost white.

(1) **Dull Colour.**—The dull and lifeless colour which is frequently noticeable in butter is invariably the result of over-working. If the butter is overworked to such an extent that the grain is destroyed, the fat loses its bright colour and the butter has a dull appearance; by careful working of the butter this defect can be avoided.

(2) **Mottled or Streaky Butter.**—Mottles and streaks are quite common defects in South African butter. They are usually caused by (1) unequal mixing of creams of different

stages of ripeness; (2) by unequal working of the butter; (3) by over-churning or insufficient washing whilst the butter is in the granular stage; (4) by the unequal distribution of salt throughout the butter. The remedies are obvious. Different creams should be well mixed and allowed to stand for some time before churning. Care should be taken to avoid over-churning, and the butter granules should be thoroughly washed; brine salting should be practised where possible, and the butter must be evenly and completely worked. If dry salting is practised the salt should be of the best quality and finely ground. It should be evenly distributed through a hair sieve over the butter whilst it is still in the granular form, and is better applied in two lots, half at a time, to allow of a more thorough incorporation in the butter. This latter practice, however, is not recommended in very warm weather, as the longer the butter is kept unworked the softer it becomes.

SUMMARY.

1. See that the cream is produced under clean, sanitary conditions and that all the utensils used in connection therewith are properly cleaned and sterilised.

2. Use every available means to churn at the correct temperatures.

3. Regulate the ripening of the cream so as to churn in about 25-30 minutes winter and summer.

4. To prepare the churn, butter worker and other wooden utensils:—

    (a) Rinse with warm water.

    (b) Scald with boiling water.

    (c) Rub with salt.

    (d) Rinse with cold water.

5. In warm weather prepare utensils overnight and churn before daybreak.

6. *Use a correct dairy thermometer.*

7. Strain cream into the churn through a muslin cloth.

8. Never overfill the churn.

9. Ventilate frequently.

10. Turn the churn at the speed indicated on the handle.

11. Do not over-churn.

12. Wash the butter twice with cold water at the correct temperature.

13. Use brine for salting.

14. *Do not overwork.*

15. Do not work the butter whilst soft.

16. Make up and wrap the butter neatly.

17. Use the best vegetable parchment for wrapping.

18. Do not store the butter in a damp, dark place.

19. Harden the butter before packing and pack in special boxes.

20. Make sure that you are acquainted with the requirements of the Act regarding the making and sale of farm butter.

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Price List of Forest-tree Transplants, Ornamental Trees and Shrubs, Hedge Plants. Creepers and Seeds.

OBTAINABLE AT THE GOVERNMENT FOREST NURSERY, SALISBURY.

1. Transplants of forest trees, etc., as far as in stock, are obtainable at the subjoined rates.

2. Orders should be addressed to the Conservator of Forests, Salisbury; or Manager, Forest Nursery, P.O. Box 387, Salisbury.

3. **All orders must be accompanied by a remittance in cash, bank note, postal order, draft or cheque, made payable to the Department of Agriculture, Salisbury. Under no circumstances will plants or seeds be sent out or taken away from the Nurseries unless paid for. Stamps to the value of one shilling will be accepted.**

4. All transplants are despatched at Rate 10 on railways at purchaser's risk. The transplants are watered as far as this is possible by the railway staff.

5. All prices quoted are for delivery free at any station or siding in Southern Rhodesia. Road motor service charges are payable by consignee and must be included in remittances.

6. Purchasers of trees contained in tins either of 25 or 4 trees are requested to return the tins, carriage forward, to the nursery from which they were obtained, or to the Manager, Forest Nursery, Salisbury. If the tins are not returned within two months from date of issue, they will be charged for at the current rate of petrol tins.

7. No trees will be reserved unless specially booked. Orders will be executed in order of receipt as trees are ready for despatch. Every effort will be made to comply with instructions of purchasers.

8. Transplants of forest trees, when quoted at per 1,000, are grown in half paraffin or petrol tins containing 20 to 25

transplants. The average weight of each tin is about 25 lbs. Height of transplants, about 3 to 12 inches.

9. Transplants of larger size, from 1 ft. to 3 ft., are also supplied four in a tin at per tree Weight of tin, about 25 lbs.

10. Shrubs and ornamental plants in single tins have a weight of about 5 lbs.

11. To purchasers of forest trees, the following reductions are made:—

(*a*) When the number exceeds 1,000, the price is £3 5s. per 1,000.

(*b*) When the number exceeds 5,000, the price is £2 14s. per 1,000.

(*c*) Special quotation for orders over 20,000.

12. Orders for seed are posted or railed free of charge.

13. Though every care is taken to supply trees and seeds true to name and of good quality, no guarantee can be given in this respect, more particularly in regard to seed.

14. Intending tree planters are invited to apply to the Conservator of Forests, Division of Forestry, Salisbury, for advice as to the most suitable trees for growing in the various climates and soils of the Colony, and on the best methods to adopt in the formation of plantations, wind breaks and shelter belts.

15. No responsibility taken after trees, shrubs, etc., have been accepted by the Railways. Any claim for loss or death should be made to the Railway Company.

16. This list cancels all previous lists.

Price of Transplants.—For convenience, the following symbols are used to indicate the purchase prices of transplants:—

A—Trees, 25 in tin, at 2s. 3d. per tin, £3 5s. per 1,000; £2 14s. per 1,000 for orders over 5,000.
C—Trees and shrubs, 4 in tin, at 4d. each.
D—Trees and shrubs, 4 in tin, at 9d. each.
E—Trees and shrubs at 9d. each; extra large up to 2s. 6d. each.

Botanical Name.	Common Name.	Remarks.	Price of trans-plants.	Price of seed. Lb.	Oz.
Callitris calcarata ...	Black cypress pine ...	Usually rather slow growing, but reaches a fair size and produces a valuable durable softwood. Suited for dry country planting, especially in sandy soil. Resistant to white ants. Good shelter for orchards, etc.	A. C.	15s.	1s.
Casuarina Cunninghamiana	Beefwood	A fine large shade tree, suitable for avenues and narrow belts, but not recommended for timber plantations. Requires deep soil in drier localities. The foliage is useful for stock fodder, and the tree stands lopping well.	A.C.	...	2s. pkt. 1s.
Cedrela odorata		A rapid-growing tree similar to Cedrela toona, but with lighter foliage. Likely to do well on heavy soils, fairly free from frost. 30 to 40 feet in height.	A.		
Cedrela toona	Toona tree...	A rapid-growing, handsome, semi-deciduous tree, suited for moister localities where frost is slight. Yields a valuable soft timber. Recommended for shade and ornament.	A. C.	15s.	1s.
Cupressus arizonica ...	Arizona cypress	A hardy evergreen tree, suitable for dry localities, but requiring a well-drained and rather deep soil. Useful for shelter belts and also for hedges when closely planted.	A. C.	15s.	1s.
Cupressus lusitanica ...	Portuguese cypress ...	A fast-growing cypress, producing an excellent softwood timber, but requires a moist, cool climate and a good soil. May well be used for shelter and hedges in favourable localities.	A. C.	5s.	6d.
Cupressus sempervirens, var. horizontalis	Common spreading cypress	A hardy cypress, suited for limestone as well as other soils. Not so frost or drought hardy as Cupressus arizonica. Suitable for shelter and hedges.	A. C.	15s.	1s.

Cupressus sempervirens, var. pyramidalis	Common upright cypress	An ornamental tree for gardens and cemeteries. Also useful as a shelter tree. Grows under similar conditions to the "var, horizontalis."	A. C.	15s.	1s.
Cupressus torulosa ...	Himalayan cypress... ...	A good tree for timber, hedges and shelter. Withstands much cold and drought. Not very soil exacting. Fairly frost-hardy. A very reliable tree.	A. C.	10s.	9d.
Eucalyptus botryoides	Bangalay	A large-leaved, heavy-foliaged gum. Quick growing. Suitable for granite and red soils. Withstands frosts, but not very drought-resistant.	A.	15s.	1s.
Eucalptus citriodora .	Lemon-scented gum ...	A clean-boled tree, producing an excellent timber. Leaves lemon-scented. Suited for wetter regions and on the better soils in the lower rainfall regions. Will not withstand much frost or drought. Flowers prolifically, rendering it very useful for honey production.	A.	15s.	1s.
Eucalyptus crebra... ...	Narrow - leaved iron-bark	A slow-growing, deep-rooting species, producing excellent timber. Suitable for well-drained soils in the higher rainfall areas. Withstands a certain amount of drought and light frosts. Will not thrive in an acid soil.	A	15s.	1s.
Eucalyptus globulus ...	Tasmanian blue gum...	A fast-growing tree, suitable for cool, moist areas with deep soils. Will not withstand drought, but is frost-resistant to a large extent. Produces a useful timber.	A.	15s.	1s.
Eucalyptus maculata ..	Spotted gum	One of the best trees for timber production or shelter in the wetter areas, being fairly hardy to drought but not to frost. Produces an excellent timber.	A.	15s.	1s.
Eucalyptus maideni ...	Maiden's gum	A very fast-growing, large tree, with bluish foliage in youth. Fairly drought and frost resistant. Will grow on poor soils if deep and well-drained. Produces a good, strong, useful timber.	A.	30s.	2s.

Botanical Name.	Common Name.	Remarks.	Price of trans-plants.	Price of seed. Lb.	Oz.
Eucalyptus melliodora	Yellow box...	A medium-sized tree, useful for shelter belts. Produces a tough, durable timber. Very resistant to drought and frost. Valuable for honey production, having abundant sweet flowers.	A.	15s.	1s.
Eucalyptus paniculata	Grey ironbark	A very good timber tree, with heavy foliage. Suitable for the moister regions, with a deep, fertile soil. Withstands some drought, but is frost-tender. Yields an excellent, hard, durable wood.	A.	15s.	1s.
Eucalyptus punctata ...	Leather jacket	A tree of fair size, yielding a good, durable timber. Adaptable as regards soil and climate, but will not withstand a dry cold climate.	A.	15s.	1s.
Eucalyptus robusta ...	Swamp mahogany	A quick-growing, shady tree, which requires a moist soil for best results, but will grow under fairly dry conditions, provided frost is not severe. Recommended rather for shelter belts than plantations.	A.	15s.	1s.
Eucalyptus rostrata ...	Red gum	Produces an excellent and durable hardwood. Withstands drought, heat, brak, flooding and a good deal of frost. One of the best species for planting in Southern Rhodesia, except in sour soil and wet mountain regions.	A.	15s.	1s.
Eucalyptus saligna... ...	Sydney blue gum	A fast-growing, useful tree, producing a useful medium hardwood. Thrives on deep, fertile soils in the heavier rainfall areas. Tender to frost and drought.	A.	15s.	1s.
Eucalyptus sideroxylon	Red ironbark	A fairly slow-growing species, suitable for dry, rocky, soils in the moister regions. Produces a good, durable hardwood.	A.	15s.	1s.
Eucalyptus tereticornis	Forest red gum	Similar to Eucalyptus rostrata, and can be planted along with it, except in areas liable to flooding and great heat. Perhaps not quite as drought-resistant.	A.	15s.	1s.

Grevillea robusta	Silky oak	A handsome tree which thrives best in moist, warm localities. Useful for ornament, shade and timber. Frost-tender and not resistant to drought. If the locality is unsuitable, it may grow well for several years and then die out.	A. C.	...	pkt. 1s.
Jacaranda mimosaefolia	Jacaranda	An ornamental tree with feathery foliage and abundant blue flowers, which appear in spring. Best development is attained in the moister regions, but the tree withstands drought to a surprising extent, and may be planted in the drier regions if the soil is reasonably deep and fertile. It is tender to cold and frost, and may need protection in its earlier youth. Semi-deciduous.	A. C.	20s.	1s. 3d. pkt. 1s.
Pinus canariensis	Canary Island Pine ...	Hardy to drought, but not to severe frost. Best suited for planting on higher altitudes and in higher rainfall areas. Slow growth in early youth, then more rapid in later years. A handsome tree with inverted, umbrella-like branches, not spreading. Yields an excellent softwood timber.	A. C.	15s.	1s.
Pinus halepensis	Aleppo pine	A drought-resistant pine which will grow on limestone and shale soils. Not recommended for plantations, but can be used for shelter and ornamental purposes in the drier regions.	A. C.	15s.	1s.
Pinus patula...	Drooping pine	A fast growing pine with graceful drooping needles. Does best in higher rainfall areas. Produces a useful softwood.	A.C.	15s.	1s.
Pinus radiata (insignis)	Remarkable pine	A large tree of very rapid growth, producing a useful softwood. Most at home in the heavier rainfall areas. Does not like sour or poorly-drained soils. Frost-hardy but not drought-resistant, usually failing at an early age in the drier regions.	A. C.	15s.	1s.
Pinus longifolia	Chir pine	A somewhat slow-growing pine, but useful to plant in localities where the climate and soil are doubtful at the higher elevations. For timber and ornamental purposes. Not frost-resistant or very drought-hardy.	A. C.	15s.	1s.

Botanical Name.	Common Name.	Remarks.	Price of trans-plants.	Price of seed. Lb.	Oz.
Populus alba	White poplar	A rapid-growing poplar, requiring a good, deep soil in close proximity to running water. Propagated by suckers. Deciduous.	Suckers at 9s. per 100		
Populus deltoidea, var. missouriensis	Carolina poplar...	A very fast-growing poplar, producing a very good timber for match boxes. Requires a rich, moist, alluvial soil. Moderately frost-hardy. Does not like stagnant water.	E.		
Salix babylonica	Weeping willow	A useful timber and ornamental tree, requiring a moist, well-drained soil which is occasionally flooded. Not suited for ground in which water is stagnant.	C.		
		Ornamental Trees, Shrubs and Hedge Plants.			
Abelia floribunda	—	A shrub with myrtle-like leaves, evergreen if watered. Pink-white flowers in profusion. Is used for hedges in Natal.	E.		
Aberia caffra	Kei apple	A rough, thorny, impenetrable shrub, making a good hedge. Withstands frost and drought well. Suited for all but the driest areas of the Colony. More useful than ornamental. Slow growing.	E.		
Acacia Baileyana	Silver wattle	A small ornamental tree with blue foliage and yellow flowers.	E.		
Acalypha marginata ...	—	Margin of leaf crimson; a shrub; will grow to 10 feet in height, or clipped to shape. Very useful to give colour to shrubbery.	E.		
Acrocarpus fraxinifolius	—	A small tree up to 25 feet in height; attractive foliage.	E.		
Agapanthus umbelatus	Cape Lily	Blue and white varieties.	E.		
Aleurites fordii...	Tung oil	An important oil-bearing tree from China. 25 to 30 feet in height.	E.		
Aloysia citriodora... ...	Lemon-scented verbena	A small shrub with a strongly lemon-scented foliage. Hardy, vigorous, quick-growing.	E.		

Alstonia scholaris... ...	—	A white flowered shrub, 6 feet high, similar to Oleander.	E.	
Anona reticulata	Custard Apple	Small deciduous bush up to 10 feet high, bearing the well known custard apple.	E.	
Bauhinia galpini	Pride of de Kaap	A rambling shrub, bearing orange-red flowers. Hardy.	E.	... pkt. 1s.
Bauhinia acuminata ...	Bauhinia	A large, indigenous shrub, flowering profusely in early spring. White flowers. Hardy.	E.	... pkt. 1s.
Bauhinia purpurea ...	Bauhinia	Similar to the Bauhinia acuminata, but with mauve flowers. Hardy.	E.	... pkt. 1s.
Bolusanthus speciosus	Rhodesian tree wistaria	An indigenous, deciduous tree with blue flowers at the end of long stalks. Ornamental.	E.	
Brugmansia Knightii	Moonflower	A flowering shrub with large, drooping, white flowers. Strong scent (of lily). Fairly frost-hardy.	E.	
Brunfelsia eximia... ..	Yesterday, to-day and to-morrow	Shrub 4 to 6 feet. Flowers change colour from purple to white as they grow older.	1s. each	
Buddleia sp.	Blue buddleia	A medium-sized shrub with sweet-scented blue flowers. Useful as a hedge. Rapid-growing, but frost-tender.	E.	
Buddleia sp.	Yellow buddleia	A rank-growing, yellow-flowering shrub. Useful as a hedge. Rapid-growing. Frost-tender.	E.	
Callistemon speciosus	Bottlebrush	A scarlet-flowering shrub of drooping habit. Makes an excellent hedge if trimmed along the top only.	A.C.E.	... 2s. pkt. 1s.
Carica papaya	Pawpaw	A small tree with a large, dark green foliage, bearing large edible fruits.	E.	
Casimiroa edulis	Mexican apple	A large, rapid-growing tree, 30-40 feet in height, evergreen, and bears a delicious fruit. A fine shade tree.	E.	
Cassia capensis...	Cape laburnum...	A rapid-growing shrub, bearing masses of bright yellow flowers.	E.	
Cestrum aurantiacum	Ink berry	A small shrub, bearing orange flowers in profusion.	E.	
Castanospermum Australe	Australian chestnut ...	A very fine shade tree similar in growth to Cedrela but with shiny evergreen leaves and pretty flowers.	2s. 6d. each.	

Botanical Name.	Common Name.	Remarks.	Price of trans-plants.	Price of seed. Lb.	Price of seed. Oz.
Croton sylvaticus	Mount Selinda linden	A large-leaved, deciduous tree from Melsetter.	E.		
Cyphomandra betacea	Tree tomato	The well-known tree tomato. Will grow anywhere where Paw Paws will thrive.	E.		
Dahlia imperialis	Tree dahlia	A medium-sized shrub, making a handsome show with its single white blooms.	E.	...	pkt. 1s.
Dalbergia sissoo	Sissoo	A large deciduous tree from India, producing an excellent timber. Desires a deep, porous, well-drained soil in close proximity to running water. Will not tolerate stiff clay. Frost-hardy, but not very drought-resistant. Rapid-growing.	E.		
Datura arborea...	Tree potato	A large shrubby tree, up to 30 feet in height, with large purple flowers. Very quick grower. Fruit poisonous.	E.		
Deutzia crenata	Bridal wreath	A small deciduous shrub with double white flowers, tinged slightly pink, on long, drooping stalks.	E.		
Dombeya sp.	—	A small shrub 6 feet high, pink flowers.	E.		
Duranta plumieri	Tree forget-me-not... ...	A medium-sized, deciduous shrub with blue flowers. Useful as a hedge. Very hardy.	E.		
Eranthemum sp.	—	A shrubby herbaceous plant covered with intense blue flowers in the autumn, likes shade, evergreen, 3 feet high.	E.		
Eugenia braziliensis ...	Brazilian cherry	A small shrub, bearing orange-coloured, edible fruits. A useful hedge plant.	E.		

Euphorbia splendens	Christ thorn	A small thorny shrub with bright scarlet flowers. Suitable for low hedges and borders.	E.
Freylinia Tropica	Inyanga hedge plant	A useful hedge shrub. Indigenous.	E.
Gardenia florida	Katjepeering	A compact, evergreen shrub with dark green, glossy leaves and pure white, sweetly-scented double flowers.	E.
Hamelia patens	—	A compact shrub 8 feet to 10 feet in height, flower orange-yellow tubes, a showy shrub.	E.
Heliotropium peruvianum	Heliotrope	A small shrub with sweet-scented lilac or nearly white flowers. Suitable in flower border.	E.
Hibiscus rosa-sinensis	Chinese rose	Evergreen shrub with numerous scarlet flowers. Double and single varieties.	E.
Holmskioldia sanguinea	Holmskioldia	A fairly hardy shrub, bearing a profusion of brick-red flowers in large bunches. Suitable for hedges.	E.
Holmskioldia sp.	Holmskioldia	A yellow-flowering, handsome shrub similar to Holmskioldia sanguinea.	E.
Hydrangea japonica	—	A well-known shrub. The flowers are naturally pink, and are changed to blue by feeding the plants with small quantities of Nitrate of Soda, as they grow.	E.
Hypericum lanceolatum	St. John's wort	A small, yellow-flowering shrub. Multitudes of flowers.	E.
Iochroma tubulosa	Iochroma	A shrub with dark blue flowers.	E.
Lagerstroemia indaca	Pride of India	A large ornamental shrub, with mauve and pink flowering varieties. Handsome and hardy.	E.
Ligustrum lucidum	Chinese privet	An excellent hedge plant or ornamental shrub. Can be clipped into shape. Liable to die off in patches or lose its lower leaves unless planted in moist soil of fair depth. Propagated from cuttings.	A.C.
Lagunaria Patersonii	—	An evergreen tree with pink flowers, 30 feet high.	E.
Mangifera Indica	Mango	The well known fruit tree.	1s. to 2s. 6d. each.
Melia azedarach	Syringa	A deciduous tree, producing a good light timber. Shallow rooting. Withstands drought well. Has fine lilac flowers and persistent yellow berries. Suitable for better rainfall areas and deep sandy soil, but will grow under severe conditions.	E.

Botanical Name.	Common Name.	Remarks.	Price of trans-plants.	Price of seed. Lb.	Oz.
Morus sp.	Mulberry	A very large fruited variety.	E.		
Moschosma	Rhodesia spirea...	A medium-sized, blue-flowering shrub.	E.		
Nerium oleander	Ceylon rose	The Oleander. Salmon-pink, also a white variety.	E.		
Parkinsonia aculeata ...	Jerusalem thorn	A light foliaged tree, up to 20 feet high, with little yellow flowers, very beautiful as isolated specimen on a lawn.	E.		
Persea gratissima	Avocada pear	A shrub with an edible fruit.	2s. 6d. each		
Philadelphus Coronarius	Mock orange...	A pretty deciduous shrub, large scented white flowers in early spring.	E.		
Photinia japonica	Loquat...	A small evergreen tree with large leaves, bearing yellow edible fruit.	E.		
Phytolacca dioica	Belhambra	A rapid-growing, deciduous tree. Useful for ornament. Timber of no value, but seeds valuable as a poultry or cattle feed.	A.	...	pkt. 1s.
Pittosporum undulatum	Camphor laurel...	An Australian evergreen shrub, making an excellent hedge, with shining, green, scented leaves and scented berries.	A.C.		
Plumiera rubra	Frangipani	A handsome shrub with pinkish red flowers. Rather delicate.	2s. 6d. each		
Plumiera occulata	—	Similar to Plumiera Rubra with white flowers.	2s. 6d. each		
Poinciana gillessii	Bird of Paradise flower	A shrub grown to 10 feet in height, thorny, flowers in clusters, orang-gold and red.	E.		
Poinciana regia	Flamboyant	A handsome red flowering, feathery foliaged tree.	E.		
Poinsettia pulcherrima	Poinsettia	A shrub with small yellow flowers surrounded by many large, scarlet, leaf-like bracts. Very showy. Double and single varieties. Also single pink variety.	E.		
Poinsettia albida	Poinsettia	As above, but with single yellowish white bracts.	E.		
Psidium pomiferum ...	Guava	A small, hardy, evergreen tree, bearing edible, yellow fruit.	D. E.		

Punica granatum	Pomegranate	A shrub or small tree, having shining leaves, large scarlet flowers and large red fruit. Makes a useful hedge when well cut regularly.	E.		
Pyracantha angustifolia	Hawthorn	Fruits golden and hang throughout the winter. Evergreen shrub. Useful as a coarse hedge.	A.C.E.		
Pyracantha crenulata ..	Hawthorn	Fruits scarlet. Evergreen shrub if watered in winter. Makes a good border or low hedge.	A.C.E.		
Rhus lancea...	Karreeboom...	A small indigenous tree of graceful appearance, yielding a very durable wood. Useful for ornamental purposes. Forms a fine hedge.	A.	10s.	9d.
Roses (bush)...	—	An assortment of roses of about fifteen kinds, Teas, Hybrid Teas and Hybrid perpetuals, are usually on hand at 1s. each. These roses are struck from cuttings, but are not named.	1s.		
Russelia juncea...	Coral fuchsia	A pretty red-flowered shrubby plant about 6 feet high.	E.		
Salvia involucra	Salvia	Shrubby herbaceous perennial, growing to six feet in height. Red flowers. Very suitable for cutting.	E.		
Spathodea campanulata	African flame tree... ...	A handsome, heavy-foliaged tree, bearing bright red flowers. Suited for the heavier rainfall areas on deep soils.	E.		
Spirea prunifolia	Cape May...	White flowered shrubs four feet in height, in single and double varieties.	E.		
Streptosolon Jamesonii	Streptosolon...	A shrub with orange-coloured flowers in dense masses and pale green foliage. Very frost-tender and delicate.	E.		
Tecoma Smithii	Tecoma	An upright, medium-sized shrub with tubular, bright yellow flowers. Forms a useful hedge. Fairly drought-resistant.	A. E.	...	pkt. 1s.
Tecomaria Capensis ...	Kaffir Honeysuckle ...	A pretty trailing shrub from the Cape, with orange flowers.	E.		
Thevetia neriifolia... ...	Thevetia	An evergreen shrub, bearing bell-shaped, yellow flowers. Hardy.	E.		

Botanical Name.	Common Name.	Remarks.	Plants each.	
Thuya orientalis	Thuya	A very hardy conifer that withstands heat, cold and drought, and does not mind heavy soils. Slow-growing. Of small size. Very good for hedges.	A.C.	... pkt. 1s.
Trichelia emetica	Natal Mahogany	A fine shade tree, evergreen, slow in growth, height to 30 feet, spread up to 50 feet.		1s. 6d. to 2s.6d.
Zithryllum sp.	—	A deciduous shrub up to 15 feet in height, grown for its lovely leaves, which become highly coloured in autumn.	E.	
		Climbers and Creepers.		
Ampelopsis veitchii ...	Virginia creeper	Too well known to need description.	E.	
Antigonon leptopus ...	Coral Creeper	A showy climber, bright pink flowers, forms large bulbs underground. Takes two or three years to reach flowering size, after this it makes a wonderful display yearly.	E.	
Aristolochia elegans ...	Dutchman's pipe	A rank-growing creeper. Heart-shaped leaves. Purplish crimson flowers, spotted yellow.	E.	
Beaumontia grandiflora	Beaumontia	A large climber with heavy, glossy foliage. Large white, bellshaped flowers. Blooms profusely. Fairly frost-tender.	1s. 3d.	
Bignonia venusta	Golden shower	Vigorous creeper. Rapid-growing. Bears masses of orange flowers all the year round. Very useful and hardy.	1s. 3d.	
Bignonia speciosa	Bignonia	A rapid-growing, showy creeper, bearing large mauve flowers. Decumbent.	E.	
Bougainvillaea splendens	Bougainvillaea	Vigorous climber. May be also used as a hedge. Bracts magenta. Fairly frost-hardy.	1s. 3d.	

Ficus repens	—	A valuable climber for walls, etc., used in places where the Virginia creeper is grown, but clings to the surface much better than the latter, rather slow at first.	E.
Hedera helix	Ivy	A dark evergreen climber. Best in shady, cool climates.	E.
Jasminum sambac	Jasmine	A vigorous, evergreen shrub climber with large trusses of fragrant, white flowers.	1s. 3d.
Jasminum primulinum	Climbing jasmine	A yellow-flowering species similar to Jasminum grandiflorum.	E.
Lantana salviaefolia	—	A fine little creeping shrub with pink flowers, very suitable for rockwork, or edging borders, etc.	E.
Lonicera periclymenum	Honeysuckle (Woodbine)	Hardy climber with sweet-scented yellow flowers.	E.
Lonicera sempervirens	Red honeysuckle	Climber with red flowers. Best kept well pruned or base becomes ugly.	E.
Mandevilla suaveolens	Mandevilla	Deciduous climber, bearing trumpet-shaped, white, fragrant flowers. Very slender.	E.
Passiflora edulis	Granadilla	A quick-growing climber, bearing edible fruits. Subject to woolly aphis if overshaded. A good trellis plant.	E.
Podranea Brycei	Zimbabwe creeper	A rank-growing indigenous creeper with large, pink flowers.	E.
Rosa bracteata	Macartney rose	Plant with large green foliage and numerous white single flowers. Useful as a hedge plant.	1s.
Solanum Wenlandii	Blue potato creeper	A rapid-growing creeper with tubular, blue flowers. Not frost-hardy.	E.
Wistaria frutescens	—	The well-known climber with lavender coloured panicles of flowers.	E.

Palms, Bamboos, etc.

Botanical Name.	Common Name.	Remarks.	Plants each.
Arundo donax	Spanish reed	A reed growing 20 feet to 25 feet in height and 1 inch thick, and very superior to the indigenous variety.	Offsets 1s. 6d. each
Bambusa fortunei	Fortune's bamboo	A small variety, 6 feet high, with canes about the thickness of a lead pencil, extremely useful for stakes in the garden.	Offsets 2s. 6d. each
Bambusa arundinacea	Whipstick bamboo	About 30 feet.	Offsets 2s. 6d. each
Bambusa sp.	Japanese striped bamboo	A very ornamental variety with golden rods marked and striped with green lines, about 20 feet.	Offsets 2s. 6d. each
Bambusa sp.	Indian variety	Similar in growth to the Bindura, with very useful rods.	Offsets 2s. 6d. each.
Cortaderia argentea ...	Pampas grass	With long white plumes about 6 feet in height; must be grown near water or close to a tap.	Offsets 2s. 6d. each
Cyperus papyrus	Papyrus Grass	A very handsome subject for the water garden, or planted near the drip of a tap; it does best when growing in the water.	2s. 6d. each
Oxytenanthera abyssinica	The Bindura bamboo ...	The only variety indigenous to Rhodesia, giving very useful solid rods, very tough.	Offsets 2s. 6d. each.
Phoenix reclinata	Date palm	A very hardy palm, indigenous to the Colony.	—
Phormium tenax	New Zealand flax	A useful green foliaged plant, about 4 feet high with sword-like leaves.	E.
Washingtonia robusta	Fan palm	A strong-growing fan palm.	—

Palms 2s. 6d. to 5s. each.

Offsets of Bamboos supplied during January only.

Second year's growth, Apple Tree on Seedling Root.

Desirable shelter of cupressus. An outer row of tall trees would furnish better results. These trees are too near the citrus trees.

The Rhodesian Home Orchard.

By G. W. Marshall, Horticulturist.

Introduction.—In this article it is proposed to deal mainly with the general purpose or utility orchard for the farm or town plot in which the owner wishes to plant a selection of fruit trees to meet the household's fruit requirements.

Fruit may be regarded as an essential part of our diet, and if we wish to maintain good health an endeavour should be made to produce throughout the year a regular supply of fruit. This is possible in many districts of Rhodesia, for we have a wide range comprising tropical, sub-tropical and temperate fruits to choose from, and with judicious selection a sequence of fruits may be produced to furnish the home requirements from January to December.

A comparison of existing home orchards in Rhodesia is enlightening. They vary from exceptionally good to extremely poor. In the former case there is evidence of a natural love for orchard management, the trees are well tended, the fruit crops are good in quality and quantity and are a real joy to the owner. In other orchards are trees planted carelessly, neglected and an eyesore to all who see them. Many of these failures are due to lack of knowledge concerning the planting and subsequent cultural requirements of the trees, to planting of varieties unsuitable for the purpose they were intended to fulfil or to the planting of more trees than were actually required or could properly be attended to.

An endeavour will be made in the suceeding pages to deal with the many factors that need consideration when establishing and maintaining a home orchard, and it is trusted that the advice tendered will be of assistance to those about to establish, extend or improve their orchards.

Selection of the Orchard Site.—The most important factors to consider when selecting a site for a home orchard are suitability in respect to—

(1) soil;
(2) shelter;
(3) aspect;
(4) irrigation possibilities; and
(5) distance from homestead.

If one or more of these factors are disregarded, poor and unprofitable fruit may very well be the result.

Soil.—The best soil for the profitable production of most fruits is a light to medium loam with good depth and drainage. Suitable soils as described above will furnish the trees with a large root-feeding area, the trees will be capable of growing to a good size, living to a great age and producing large crops of good fruit. If there is no soil of this nature available it then becomes necessary to be content with a heavier soil. Heavy soils, however, are undesirable; they are more difficult to work, and the quality of the fruit they produce is often poor, particularly during the wet seasons, and they should be avoided if lighter soils are available.

On shallow soils with impervious sub-soils young trees may thrive and flourish for a few years, but when the roots encounter the objectionable sub-soil the trees will rapidly decline or die and prove a great disappointment to the owner.

The minimum depth of a good fruit tree soil should be not less than four feet, and to this depth the land should be naturally well drained. Soils containing small stones throughout their entire depth or those overlying gravelly sub-soils are suitable for tree-planting, provided the tree roots are able to penetrate to the requisite depth, namely, four feet or more.

Shelter.—Owing to the harmful effect of dry winds during spring or the blossoming months upon the setting of the fruit, it is imperative that all orchards should be adequately protected from such winds. Having selected a suitable soil for the orchard, shelter belts, unless already existing naturally, should be established without delay. It is to the advantage

of the fruit trees if shelter belts which are required to be established are planted a few years in advance of the orchard they are to protect.

Young fruit trees require protection from the time of planting if the best results are to be assured. This is not always feasible, however, particularly with new arrivals to the country who desire to establish orchards without unnecessary delay. In instances such as this the shelter trees should not be planted later than the fruit trees they are to protect, and meanwhile rows of some of the more quick-growing temporary shelter plants may be grown at close intervals around and through the orchard to afford temporary protection until the permanent trees become effective.

When the orchard is enclosed, as it should be, by wire netting or fencing to exclude domestic animals, small buck and ground vermin, a temporary shelter can quickly be produced by planting granadilla vines at ten feet intervals along the fences; when the vines have covered the fence a few additional strands of wire may be erected above to enable the vines to form a screen of at least six feet in height. Other creepers may be used in place of the granadilla, but the latter is preferable, as it produces an edible fruit. Bananas and plantains are useful shelter plants; they grow quickly and produce good fruit. Dahl also is useful for a temporary hedge, the foliage and grain being valuable poultry feed.

The best time of the year to plant all shelter trees is during the months of December and January; by planting at this season, when rains are usually frequent, it should be possible to establish the trees before the dry season commences. It is seldom necessary to plant shelter trees on more than three sides of the orchard, the idea being to exclude the prevailing hot and dry winds that are prevalent from July to November. The sides of the grove usually requiring protection are the south-east and north-west, as it is from these directions that most of the winds are experienced. If the west, south and east sides are protected, little or no tree or fruit injury will occur. No shelter trees should be planted nearer than 60 feet to 70 feet from the fruit trees; this distance appears to be ample for Rhodesian requirements.

The varieties of trees recommended for shelter belts are: Tall-growing trees for outer rows—*Eucalyptus tereticornis* and *Eucalyptus saligna;* the latter do best at the higher elevations. If eucalyptus trees are objected to and the soil is sufficiently light, *Pinus radiata* will be found suitable for the outer rows, and for the inner rows, *Cupressus torulosa* and *Cupressus lusitanica*, but the last named only where the rainfall is heavy or irrigation is possible.

Many other varieties are suitable and may be planted, but those specially mentioned will furnish a range to select from for average climatic conditions.

When two or more rows of trees are planted to form a shelter belt they should be spaced 8 feet apart in the rows and 10 feet between the rows. "Staggered" trees give the best results, i.e., like the teeth of a saw.

Aspect.—The best aspect to select for the orchard is one with a gentle southern and eastern slope. Northern and western aspects are often undesirable. The slope of the site should not be excessive, or soil erosion will be liable to occur during heavy rain storms or irrigation. The best slope will vary with the nature of the soil, but it should never, if possible, exceed one in a hundred.

Irrigation Possibilities.—Preference should be given to a site capable of being irrigated by gravitation, provided the shelter, soil and aspect factors are right. Good fruits may be grown in Rhodesia without irrigation, but if irrigation can be made available, so much the better.

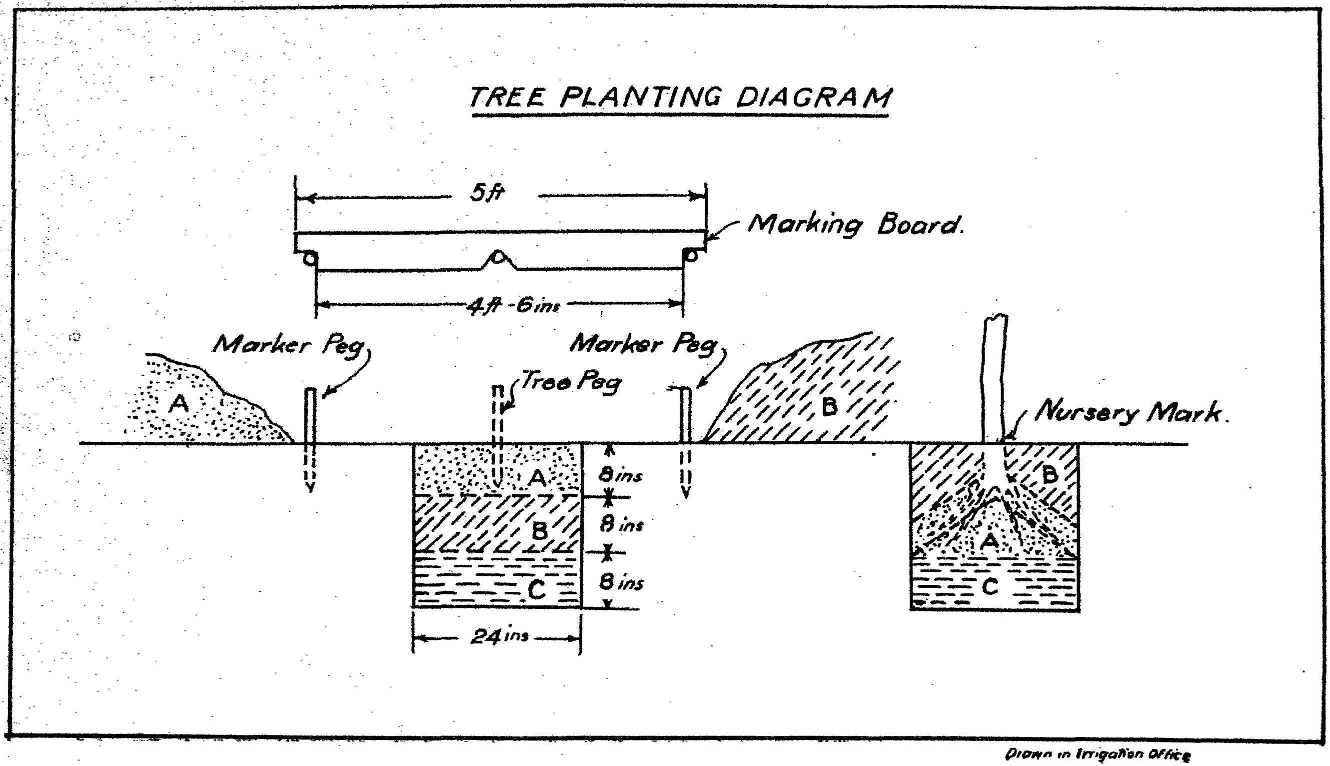
Distance from Homestead.—The orchard site should be as near the homestead as possible, but the other factors must not be disregarded when making the choice. Orchards distant from the homestead are more liable to be neglected, cannot be kept under such close supervision and are subject to greater losses through depredations by birds and by theft.

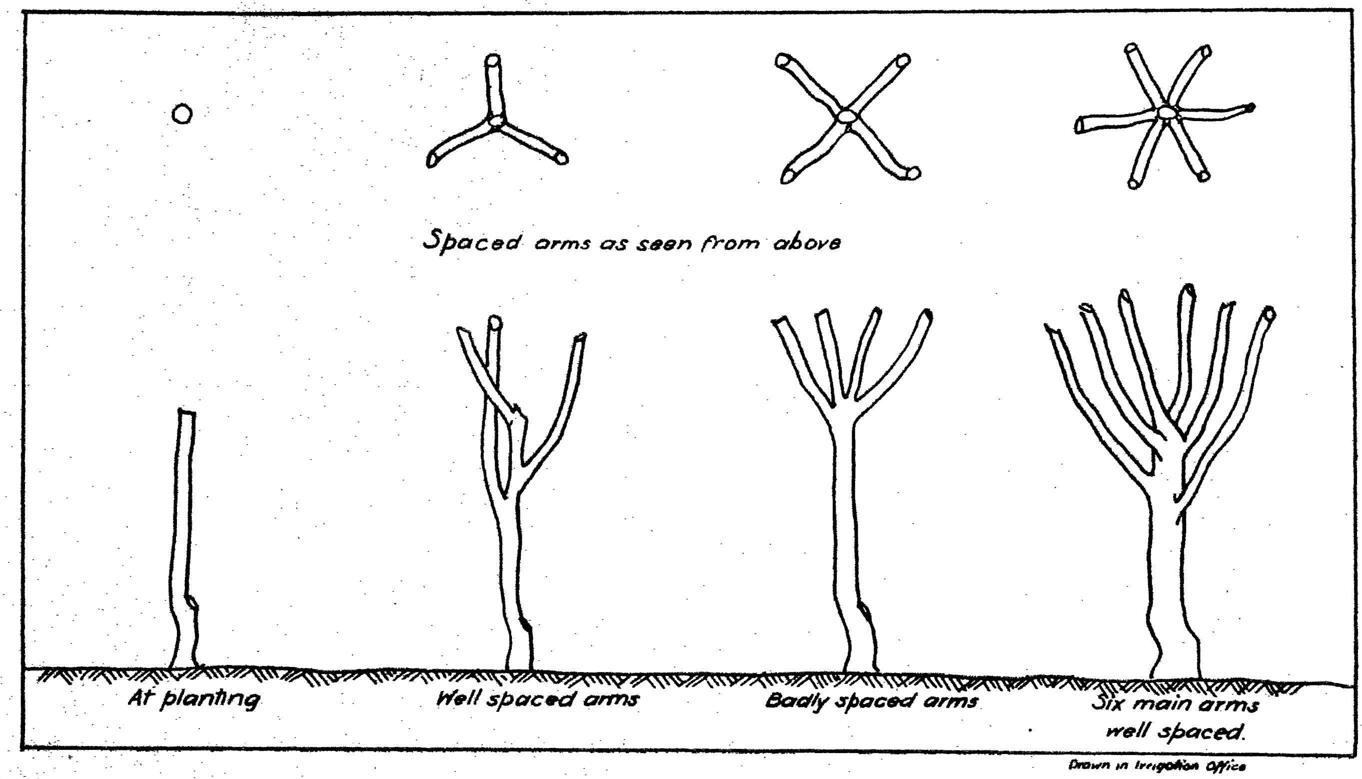
Preparation of Land.—After the selected site has been cleared of its timber, etc., it should be deeply ploughed and brought into good tilth; this is possible if performed towards the end of the rainy season—about March. When the ground is prepared at this season most of the soil moisture will be

conserved and the later operation of digging the holes will be made easier. When irrigation is possible it is also necessary to give careful attention to the problem of how the proposed site can best be irrigated. In such cases the advisability of grading the land before the trees are planted cannot be too strongly emphasised, as the efficiency of the irrigation scheme so much depends upon the proper grading of the site. After grading, the whole area should be re-ploughed, cultivated and brought into the best possible condition, and if it can be arranged a local irrigation should be given to ascertain which fall will be most suitable for planting the rows. The rows should preferably be short, with not more than 15 trees to each row. Such rows would be 120 yards in length and the fall should be about 6 inches per 100 feet, according to the nature of the soil; sandy soils require a greater fall than those of a medium or heavy character. When trees are planted on an ungraded soil continuous trouble will confront the grower, and it is neither easy nor economical to grade the slopes of an established orchard, this work should be done prior to planting. The additional cost of a properly graded site is more than justified on account of the ease with which all of the cultural and irrigation operations may be performed. On ungraded slopes the trees will receive irregular supplies of water, and this in turn will necessitate more frequent irrigation. Depth of ploughing will also be uneven; silting will occur in the depressions, thereby endangering the health of many of the trees.

Laying out the Orchard.—After preparing the chosen site in a thorough manner it should be carefully laid out with the rows of trees planted along the contours, where necessary, allowance being made to permit of the irrigation water flowing evenly without displacement of the soil. The necessary appliances for the pegging out of the site are:—

A planting wire or strong garden line to set about six pegs at a time (42 yards). For this purpose No. 16 galvanised wire could be used, and lumps of solder or rings of wire should be connected at the distances apart it is intended to space the trees. A 3-inch ring must be attached to each end of the line 3 feet from the end solder mark. This facilitates


TREE PLANTING DIAGRAM
5ft
Marking Board.
4ft -6ins
Marker Peg
Marker Peg
Tree Peg
A
B
Nursery Mark.
A
B
C
8ins
8ins
8ins
24ins
B
A
C
Drawn in Irrigation Office


Spaced arms as seen from above
At planting
Well spaced arms
Badly spaced arms
Six main arms
well spaced.
Drawn in Irrigation Office

the adjusting of the wire to its position when the pegging operation is proceeding. Two half-inch iron pins 18 inches in length will be suitable to hold the line in position while the marker pegs are being set. Sufficient wooden pegs 12 inches to 18 inches in length and about 1 inch in diameter should be available to allow three pegs for each tree to be planted.

The square system is the best for the laying out of the orchard, as it facilitates all cultural operations, chiefly on account of the wider middles (space between the rows of trees). It permits of ploughing and cultivation being carried out in four directions, and each tree has a greater root-feeding area than that obtained in other systems of planting.

The procedure to adopt when pegging the site is as follows:—Set the first line of pegs parallel but at least 60 feet distant from the windbreak, provided the fall is suitable for irrigation. When the base line is completely pegged the end lines should then be set at right angles to it and then pegged. The unpegged side should next be checked to ascertain if it is the same length as the base line, and if it is found to be incorrect it will then be necessary to adjust one end line to correct the error. The fourth side may then be pegged. We now have the site completely enclosed with the outer row pegs. Presuming that a six-peg wire is being used, it will then be necessary to peg every sixth line parallel to the base line; when this is completed the filling in will be simple. The line should be set between the base line and sixth row pegs and the four intervening pegs set. This filling in is then repeated until the end of the section is reached, after which the marking wire should be set from the sixth row to the eleventh row peg and the four intervening pegs set; this filling in process is then repeated until all the pegs are set.

After the area is completely pegged, and if it is intended to dig the holes at once, the whole site must be doubly pegged to permit of digging the holes where the tree pegs stood. This pegging is simple if a suitable marking board is made as illustrated in Fig. I. The second pegging may be commenced from any corner of the site and can be continued row by row until completed.

Place the central notch of the marking board close against the tree peg, then set the two marker pegs in the end notches of the board, which may then be moved to the next peg, when the process is repeated until the site is completely double pegged. The tree pegs may be left standing, as they assist the hole-digger to locate the exact spot the tree is to occupy.

Digging the Holes.—All tree holes should be dug, if possible, several weeks before the planting of the trees is begun, and when this is possible the holes should be refilled with good soil soon after digging is completed to permit of the earth settling down, and thus eliminating the danger of the trees sinking too deeply, as is often the case where trees are planted immediately after the digging of the hole. The size of the holes for the trees should be at least 2 feet *square* (not round) and 2 feet deep.

The digger must first mark the size of the hole round the tree peg before withdrawing it. He should then dig out 8 inches of surface soil and place it on a site unoccupied by a marked peg. The second 8 inches of soil is then placed on the opposite side of the hole and the bottom 8 inches of soil is loosened and left in the hole. This procedure is best for soil of good depth and quality.

If the sub-soil is inferior to that of the surface soil the first 8 inches of soil should be placed as previously suggested and the remaining 16 inches be dug out from the hole and discarded, the hole being then two-thirds refilled with good surface soil collected from near by, the 8 inches of surface soil previously taken out being used to complete filling. When hard-pan is encountered it is advisable to break it with dynamite (agricultural). The explosion will shatter the hard-pan to a great depth and allow roots to penetrate in all directions. When dynamite is correctly used a pot-hole will be formed where the explosion took place; this hole should be closed and firmed, otherwise trees planted above it will gradually subside and eventually stand in a deep basin. This condition is very undesirable owing to water accumulating round the stem of the tree after irrigation or rain.

Planting Distances.—For best results most varieties of fruit trees should be spaced at certain specified distances. This is possible in commercial plantings, where large numbers of a fruit variety are planted. In the home orchard it is different, as often fruit trees that require various espacements must be planted in a small area. This difficulty may be overcome by arranging the varieties in such a manner that the short-lived trees may be rooted out when their neighbours or larger-growing trees require the additional space. Suitable distances for planting fruit trees are as follows:—

Variety.	Distance apart each way.
Pecan nut and walnut	48 ft.
Seedling orange and seedling Avocado pear, grafted orange, lemon, naartje, Tahiti lime, grape fruit, litchi, guava and pear	25 ft.
Almond, quince, West Indian lime, plum, peach, apple, apricot, nectarine, fig, cherry, custard apple, persimmon	20 ft.
Paw-paw, banana, plantain, tree tomato and Chinese guava	10 ft. to 12 ft.

It is not necessary or possible to plant the assortment stated, but it is often necessary to plant a mixture of trees requiring different espacement, which may be arranged as follows:—

N 12 ft.	T 12 ft.	S 12 ft.	T 12 ft.	N 12 ft.	T 12 ft.	S
T	T	T	T	T	T	T
S	T	S	T	S	T	S
T	T	T	T	T	T	T
N	T	C	T	N	T	C
T	T	T	T	T	T	T
C	T	C	T	C	T	C

N denotes Pecan nut trees ... 48 ft. apart.
S denotes Stone fruit trees ... 24 ft. apart.
C denotes Citrus trees ... ... 24 ft. apart.
T denotes Paw-paw trees ... 12 ft. apart.

The average profitable life of these trees would approximately be: Pecan nut 100 years, stone fruit 10 years, citrus fruits up to 30 years or over, paw-paw 5 years.

From the profitable ages given it will be seen that all the T's could be removed after the fifth year, thus giving additional space to the N's and S's. The S's would then be removed at the end of the tenth year to provide the N's with sufficient space to develop fully. This system of interplanting short-lived trees between trees that grow to a large size and live to a great age is to be commended as the most satisfactory method for the lay-out of the home orchard.

Ordering of Trees.—When purchasing fruit trees for planting they should be ordered well in advance of the planting season. It is best to buy the trees from reputable nurserymen who raise good and healthy trees from selected parents. First-sized trees only should be used; smaller trees are often undesirable and seldom give good results.

Time of Planting.—Deciduous fruit trees should be planted when they are dormant (have shed their leaves), the best months being June and July: the later month is somewhat late for many varieties of sub-tropical peaches, and these should, according to circumstances, be planted in June or even as early as May.

Citrus and other evergreen fruit trees may be planted at any season of the year, provided irrigation facilities are available and the trees are not in active growth. When only a few trees are to be put out, and assuming they are procurable, August is as good a month as any in which to plant. Given good attention and a full growing season, August-planted trees will out-grow those planted later in the year. For extensive plantings, however, the rainy season should be chosen, for then there is less danger of losses amongst the plantings. January is the best month if the trees are dormant. Trees planted this month will do better than those planted later, as they are more capable to withstanding any unfavourable climatic conditions which may occur during the following winter.

Choosing Varieties to Order.—For the home orchard it is advisable to select, as far as possible, varieties that are known to do well in the locality in which it is intended to plant. Well established nurserymen are often the best advisers in this respect, for they make a speciality of raising trees that do well in particular districts, their advice being based on repeat orders received from these areas.

Southern Rhodesia produces fruit ranging from temperate to tropical, for in the tropics high altitudes gives large sections of country a temperate climate. It is, however, advisable to plant most varieties that are known to thrive and yield fruit under sub-tropical conditions. It is also well to plant varieties to give, if possible, a sequence of fruit throughout the year. With the home orchard, owing to the greater variety of fruit trees planted, there is seldom the necessity to consider inter-pollination. When a few varieties of each fruit are planted, pollination is usually good. Fruits such as the Ohinemuri apple, Doyenne du Comice pear and most almonds are self sterile, *i.e.*, they are incapable of pollination with their own pollen. Sometimes the male and female flowers mature at different periods and this prevents natural pollination. Walnuts also are often affected in this way. To counteract this difficulty the Ohinemuri apple tree must be planted next to the White Winter Pearmain apple, Comice pear next to the Beurre Bosc, and the Wickson plum next to Kelsey. This inter-pollination is to be considered more by the commercial planter than the home orchardist, but even by the latter it should not be disregarded.

The commercial grower in the past often planted pure blocks of one or more of such varieties, with disastrous results. When these blocks of one variety were grafted to two or more varieties blossoming at the same time, alternative rows having been cut down and re-grafted, the trees started bearing as soon as the top-worked trees blossomed.

For the guidance of new growers, a list of suitable fruits is here given for the different elevations of Rhodesia:—

FRUIT VARIETIES FOR RHODESIA.

E—indicates Early Variety.
M—indicates Mid-Season Variety.
L—indicates Late Variety.

	Tropical Under 400 ft.	Sub-Tropical 4—5000 ft.	Temperate. Over 5000 ft.
Apples...	Rome Beauty ... L	Rome Beauty ... L Versfeld... ... ... L Carrington (Alma) ... ... E American Lady (Xmas) ... ... E	Rome Beauty ... L Versfeld... ... ... L Rhode Island Greening ... L Ohinemuri ... ... L Jonathan ... ... M Blenheim Orange Pippin ... ... M Delicious ... ... M
Pears		Keiffer Hybrid L le Comte ... ... M	Keiffer Hybrid L le Comte ... ... M Clapp's Favourite E Bon Chretien ... E Beurre Bosc ... M Glout Morceau L
Quinces		Cape Selected Meeche's Prolific Champion	Cape Selected. Meeche's Prolific. Champion.
Peaches ... ... Y indicates yellow flesh.	Killiecrankie ... E Waldo ... ... E Angel ... ... M	Killiecrankie ... E Bell's November E Watt's Early ... E Jewel ... ... E Brook ... ... M.Y. Florida Gem ... M Florida Crawford M.Y. Shackleford ... M	King Edward VII. E Oklahoma Queen E Duke of York... E Florida Crawford M.Y. Early Crawford M.Y. Mamie Ross ... M St. Helena ... L.Y.
Nectarines...			Early Rivers ... E Gold Mine ... ... M
Plums—			
Red Flesh	Satsuma... ... ... M Santa Rosa... ... E	Santa Rosa ... ... E Satsuma... ... ... M	Santa Rosa ... ... E Satsuma... ... ... M
Pink Flesh		Beauty ... ... E	Beauty ... ... E
Yellow Flesh ...		Wickson... ... ... M Kelsey L	Wickson... ... ... M Kelsey ... ... L Burbank... ... ... M
Apricots		Alpha... ... ... E Early Cape ... ... E	Alpha ... ... E Early Cape ... ... E
Figs	White Genoa	White Genoa Adam	White Genoa Adam

	Tropical Under 4000 ft.	Sub-Tropical 4—5000 ft.	Temperate Over 5000 ft.
Walnuts		Japanese	English
Pecan Nuts	Success Stuart	Success Stuart	Success Stuart
Almonds			Britz Jordon I.X.L. Paper Shell
Cherries			Belle of Orleans Napoleon Black Tartarian
Oranges	Washington Navel E Premier (Joppa) M Valencia Late ... L Seville (Marmalade)	Washington Navel Premier (Joppa) M Valencia Late ... L Seville (Marmalade)	
Grape Fruit	Triumph	Triumph	
Naartjes	Old Cape Emperor	Old Cape Emperor	
Lemons	Eureka Villa Franca	Eureka Villa Franca	
Lime	Tahiti	Tahiti	
Other Citrus ... ... (for preserves)	Kumquat Pompelmoes	Kumquat Pompelmoes	
Avocado Pears ...	Selected Seedling Budded Fuerte Budded Spinks Budded Gottfried Budded Linda	Selected Seedling Fuerte Spinks Gottfried Linda	
Mango	Selected Seedlings Kidney Peach	Selected Seedlings Kidney Peach	
Litchi	Layered Trees	Layered Trees	
Custard Apple ...	Seedling Cherimoier	Seedling Cherimoier	
Guavas	Dwarf Strawberry Selected Seedlings	Dwarf Strawberry Selected Seedlings	
Loquats	Selected Seedlings	Selected Seedlings	
Mulberry	Hick's Everbearing	Hick's Everbearing	English
Persimmon		Most varieties	

	Tropical Under 4000 ft.	Sub-Tropical 4—5000 ft.	Temperate Over 5000 ft.
Banana	Ducasse Hybrid Custard Lady's Finger	Ducasse Hybrid Lady's Finger	
Grape Vines	Catawba	Catawba White Hanepoot Red Hanepoot Barbarossa Crystal	Catawba White Hanepoot Red Hanepoot Barbarossa Crystal
Other Fruits	Vumba Strawberry Tree Tomato Pineapple (Cayenne) Paw-Paw	Vumba Strawberry Tree Tomato Paw-Paw Raspberry (Red Cuthbert)	Vumba Strawberry Blackberry Raspberry (Red Cuthbert) Loganberry

Description of varieties will be found in nurserymen's catalogues.

(*To be continued.*)

SOUTHERN RHODESIA.

Locust Invasion, 1932-38.

Monthly Report No. 71. October, 1938.

During October numerous flying swarms of the Red Locust (*Nomadacris septemfasciata,* Serv.) have been reported. Most districts in the Colony have reported swarms, except those in the extreme south and north-west. Fifteen districts in Mashonaland have been invaded, namely, Charter, Chilimanzi, Gutu, Hartley, Inyanga, Lomagundi, Makoni, Mrewa, Marandellas, Mazoe, Melsetter, Ndanga, Salisbury, Umtali and Victoria, and seven districts in Matabeleland, namely, Bulalima-Mangwe, Gwanda, Gwelo, Insiza, Matobo, Nyamandhlovu and Sebungwe.

The Eastern districts have been heavily invaded by swarms from Portuguese East Africa.

Considerable damage has been caused to early grazing and some wheat crops have suffered.

New spring foliage on indigenous trees has been badly damaged.

The direction of flight has been variable.

J. K. Chorley,
Acting Chief Entomologist.

Southern Rhodesia Veterinary Report.

SEPTEMBER, 1938.

DISEASES.

Anthrax was diagnosed on the Bindura Commonage Mortality: Two head of cattle.

TUBERCULIN TEST.

Five bulls and 12 cows were tested upon importation with negative results.

MALLEIN TEST.

Fifty-two horses and 12 mules were tested. No reactors.

IMPORTATIONS.

From Union of South Africa.—Bulls 13, cows 12, horses 41, mules 12, sheep 716, pigs 6.

From Bechuanaland Protectorate.—Sheep 879, horses 5.

EXPORTATIONS.

To Union of South Africa.—Oxen 441, cows 28.

To Northern Rhodesia.—Oxen 618, bulls 10.

To Portuguese East Africa.—Oxen 105, cows 2, bulls 3.

To Nyasaland.—Horses 4.

EXPORTATIONS—MISCELLANEOUS.

To United Kingdom.—Chilled beef quarters, 5,798; frozen boned beef quarters, 332; kidneys, 5,556 lbs.; tongues, 2,859 lbs.; livers, 23,844 lbs.; hearts, 474 lbs.; tails, 9,265 lbs.; skirts, 2,582 lbs.

To Northern Rhodesia.—Beef carcases, 2,850; pig carcases, 55; veal carcases, 10.

To Belgian Congo.—Beef carcases, 168; boned beef carcases, 6.

Meat Products.—From Liebig's Factory.

To Union of South Africa.—Corned beef, 81,230 lbs.; beef fat, 24,000 lbs.; meat paste, 585 lbs.; tongues, 1,080 lbs.

To United Kingdom.—Meat extract, 21,676 lbs.; beef powder, 79,064 lbs. ...

To Northern Rhodesia.—Meat meal, 2,000 lbs.

B. L. KING,
Acting Chief Veterinary Surgeon.

Rhodesia Weather Bureau.

OCTOBER, 1938.

Pressure.—Mean barometric pressure for the month was about normal over the whole country.

Temperature.—Mean temperatures were about 1° F. above normal over the whole country and the humidity was appreciably higher than normal.

Rainfall.—The usual showers occurred early in the month, and appreciable rain was recorded starting on the 19th and continuing to the 26th, with a second fall starting on the 31st. The total for the month was above normal for Matabeleland but below for Mashonaland.

PRECIPITATION.

Station.	Inches.	Normal.	No. of Days.
Beitbridge	3.07	0.85	6
Bindura...	Nil	0.59	—
Bulawayo	0.87	0.74	5
Chipinga	1.22	1.51	5
Enkeldoorn...	0.51	1.05	1
Fort Victoria	1.14	0.90	2
Gwaai Siding...	0.87	0.41	8
Gwanda	0.61	0.79	7
Gwelo	0.59	0.67	5
Hartley...	0.94	1.03	6
Inyanga	1.41	1.12	3
Marandellas	0.67	1.28	2
Miami	0.24	0.37	2
Mount Darwin	Nil	0.39	—
Mount Nuza...	3.19	1.11	6

Station.	Inches.	Normal.	No. of Days.
Mtoko	0.18	0.62	1
New Year's Gift...	1.07	0.92	4
Nuanetsi	0.60	0.93	4
Plumtree	1.89	0.74	9
Que Que	1.93	0.73	6
Rusape...	0.80	0.76	3
Salisbury	0.71	1.10	5
Shabani	2.73	0.67	4
Sinoia	0.40	0.83	3
Sipolilo	Nil	0.48	—
Stapleford	3.45	1.78	6
Umtali	0.87	1.08	5
Victoria Falls...	1.35	0.53	9
Wankie	0.61	0.36	5
Abercorn	0.34	—	4
Balovale...	2.87	—	10
Broken Hill	0.63	—	4
Choma	0.22	—	3
Fort Jameson	Nil	—	—
Fort Roseberry	1.83	—	—
Isoka	0.22	—	3
Kasama	Nil	—	—
Kasempa	2.63	—	5
Livingstone	2.04	—	8
Lundazi	0.30	—	1
Lusaka	0.11	—	3
Mazabuka	0.89	—	3
Mongu	2.92	—	11
Mpika	0.03	—	1
Mporokoso	2.45	—	10
Mufulira	2.21	—	4
Mumbwa	1.92	—	5
Namwala	1.32	—	5
Ndola	0.60	—	4
Petauke	0.71	—	6
Senanga	1.58	—	7
Sesheke	0.05	—	2
Shiwa Ngandu	0.04	—	2
Solwezi	3.38	—	8

OCTOBER, 1938

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	8-30 a.m. Wet Bulb.	8-30 a.m. Dew Point	8-30 a.m. Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Beitbridge...	1,500	75.6	66.4	61	11.4	88.0	67.0	77.5	103	13	61	20	20	...	20	...	76.5	965.2	883.3	...	4.2	...
Bindura...	3,700	75.5	63.1	55	15.1	88.5	63.4	76.0	96	18	53	3	25	...	7	...	74.1	...	...	...	1.7	...
Bulawayo	4,393	72.0	59.6	49	14.1	85.7	61.3	73.5	97	8	55	4	19	...	3	...	72.9	870.2	881.6	868.3	3.2	8.0
Chipinga	3,685	72.7	62.8	56	11.8	83.0	59.3	71.2	95	17	54	2	13	...	...	...	69.8	894.0	883.9	...	3.1	...
Enkeldoorn	4,788	72.1	59.1	49	15.0	84.8	58.0	71.4	92	18	50	3	11	...	2	...	69.8	858.5	882.0	...	1.3	...
Fort Victoria... ...	3,571	71.7	62.0	56	11.1	86.3	61.1	73.7	96	17	53	4	19	2	5	...	73.3	896.3	882.2	894.8	2.6	...
Gwaai Siding... ...	3,278	77.8	64.1	55	18.3	95.4	63.9	79.7	103	8	53	1	28	...	12	...	...	904.4	881.2	...	2.8	...
Gwanda...	3,233	73.5	62.1	54	13.7	87.8	63.5	75.6	100	17	55	4	23	1	9	...	74.5	906.8	882.8	...	3.2	...
Gwelo	4,629	72.4	59.8	51	14.4	85.2	59.4	72.3	94	18	52	3	14	...	...	...	71.3	863.2	881.9	...	2.1	...
Hartley...	3,879	75.9	60.8	50	18.9	89.2	61.6	75.4	96	13	54	3	27	...	4	...	74.9	886.0	881.5	...	1.2	...
Inyanga...	5,503	72.3	58.3	47	16.1	80.3	56.9	68.6	88	18	48	12	3	...	...	...	66.7	...	...	...	2.3	...
Marandellas	5,453	70.0	57.7	48	13.5	81.2	57.3	69.2	88	19	51	3	2	...	...	...	67.1	...	...	...	0.7	...
Miami	4,090	74.3	61.6	53	15.2	87.0	62.2	74.6	94	18	54	1	20	...	5	...	73.4	879.1	881.1	...	1.1	...
Mt. Darwin	3,179	76.5	63.6	55	16.4	89.8	64.2	77.0	98	19	55	1	27	...	10	...	77.3	...	...	...	2.1	...
Mount Nuza	6,668	59.8	54.9	51	4.9	69.5	51.8	60.6	80	18	46	6	...	16	...	...	58.1	802.9	882.5	...	4.7	...
Mtoko	4,141	73.5	60.3	51	15.3	82.5	62.0	72.2	90	18	56	3	7	...	4	...	71.1	879.0	882.6	...	1.6	..
New Year's Gift...	2,690	73.3	64.3	59	10.9	87.8	61.1	74.4	97	13	56	4	24	...	1	...	...	...	...	...	...	8.7
Nuanetsi	1,581	76.6	67.2	62	12.3	90.2	63.8	77.0	104	13	55	5	22	1	11	...	...	963.3	883.6	...	4.6	...

OCTOBER, 1938 (continued)

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	Wet Bulb.	Dew Point	Vapour Press Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute: Maximum	Date	Minimum	Date	Number of Days: Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Plumtree	4,549	73.0	59.9	51	15.0	85.5	62.6	74.1	95	17	57	11	19	1	7	...	72.3	...	...	...	2.6	...
Que Que	3,999	73.9	61.8	54	14.3	89.2	61.8	75.5	96	18	55	3	26	...	1	...	81.4	882.5	881.7	880.4	1.2	...
Rusape	4,648	71.0	59.1	50	13.4	83.3	56.6	69.9	91	18	49	3	7	...	..	...	69.0	..	...	...	1.0	...
Salisbury	4,831	71.9	58.7	49	15.0	84.4	59.0	71.7	91	13	51	1	11	...	1	...	71.5	857.3	881.8	855.4	0.9	10.1
Shabani	3,131	74.5	62.9	55	13.8	88.3	64.2	76.2	100	13	56	4	23	1	12	...	74.5	...	...	...	2.5	...
Sinoia	3,795	76.9	63.1	54	18.3	89.8	60.8	75.3	96	13	51	3	27	...	3	...	74.9	...	...	...	1.0	...
Sipolilo	3,876	76.5	63.1	54	17.6	86.7	64.5	75.7	93	13	59	1	19	...	11	...	...	...	...	...	2.2	...
Stapleford	5,304	64.9	58.3	54	7.0	75.5	53.3	64.4	86	18	39	3	1	3	...	1	62.8	...	...	...	3.3	...
Umtali	3,672	72.2	62.7	57	10.2	86.7	61.6	74.2	98	18	54	3	19	...	2	...	71.8	894.3	883.3	892.4	2.7	...
Victoria Falls... ...	3,009	80.4	64.4	54	21.1	96.7	66.6	81.7	105	18	57	1	28	...	18	...	79.8	...	...	...	2.2	...
Wankie...	2,569	82.8	66.4	56	22.9	97.8	72.0	84.9	106	19	65	1	28	...	29	...	84.2	926.3	880.7	...	1.7	...
Abercorn	5,407	70.0	58.1	49	13.1	83.7	59.6	71.7	89	20	55	31	9	...	...	...	...	837.7	880.8	...	0.9	...
Broken Hill	3,920	74.4	61.0	51	16.5	89.0	64.1	76.6	96	19	55	1	27	...	8	...	...	884.2	880.4	...	2.5	...
Chipili	3,900	71.7	62.1	56	11.1	93.2	61.5	77.4	100	19	50	1	31	...	9	...	...	...	...	...	...	...
Fort Jameson ...	3,620	77.1	62.3	52	19.4	88.8	68.1	78.4	94	19	58	1	28	...	22	...	...	888.1	881.3	...	1.3	...
Kasama...	4,700	73.4	60.8	52	14.7	38.8	61.0	74.9	94	19	54	1	31	...	...	...	...	864.4	880.8	...	...	...
Kasempa	4,500	70.8	62.2	57	9.9	87.5	57.0	72.3	95	18	44	1	22	...	...	...	...	...	...	...	...	...
Livingstone	3,140	76.1	62.9	54	16.8	95.8	68.2	82.0	104	19	60	1	28	...	21	...	80.2	910.6	880.4	908.2	3.3	8.5
Lusaka	4,193	75.3	61.2	51	17.4	88.0	64.8	76.4	95	19	59	1	23	...	12	...	...	875.1	880.4	...	3.0	...
Mongu	3,475	76.0	64.7	57	14.0	96.7	66.5	81.6	103	5	62	26	30	...	20	...	...	896.2	879.2	...	2.9	...
Mpika	4,625	73.8	60.3	49	15.9	36.6	60.6	73.6	91	19	51	2	22	...	2	...	...	863.0	881.1	...	1.6	...
Mwinilunga	4,450	66.6	62.1	59	5.0	85.9	57.3	71.6	91	14	50	2	19	...	...	...	...	...	...	...	...	...
Ndola	4,140	72.6	60.6	52	13.9	89.1	61.7	75.4	95	19	55	8	27	...	1	...	...	875.7	880.7	...	2.0	...

Rainfall in October, 1938, in Hundredths of an Inch. Telegraphic Reports.

:ea	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total
1	...	...	...	...	...	...	...	...	...	1	5	...	...	...	...	...	5	3	43	4	...	5	12	20	1	...	10	2	...	10	10	131
2	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	82	1	...	...	...	...	...	...	...	...	...	...	69	154
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